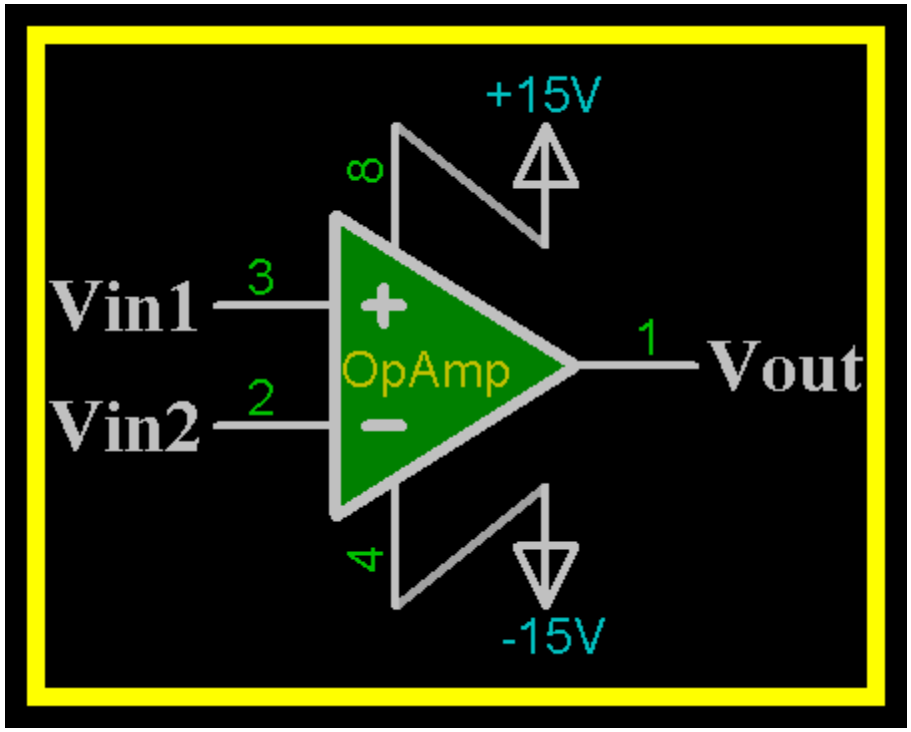
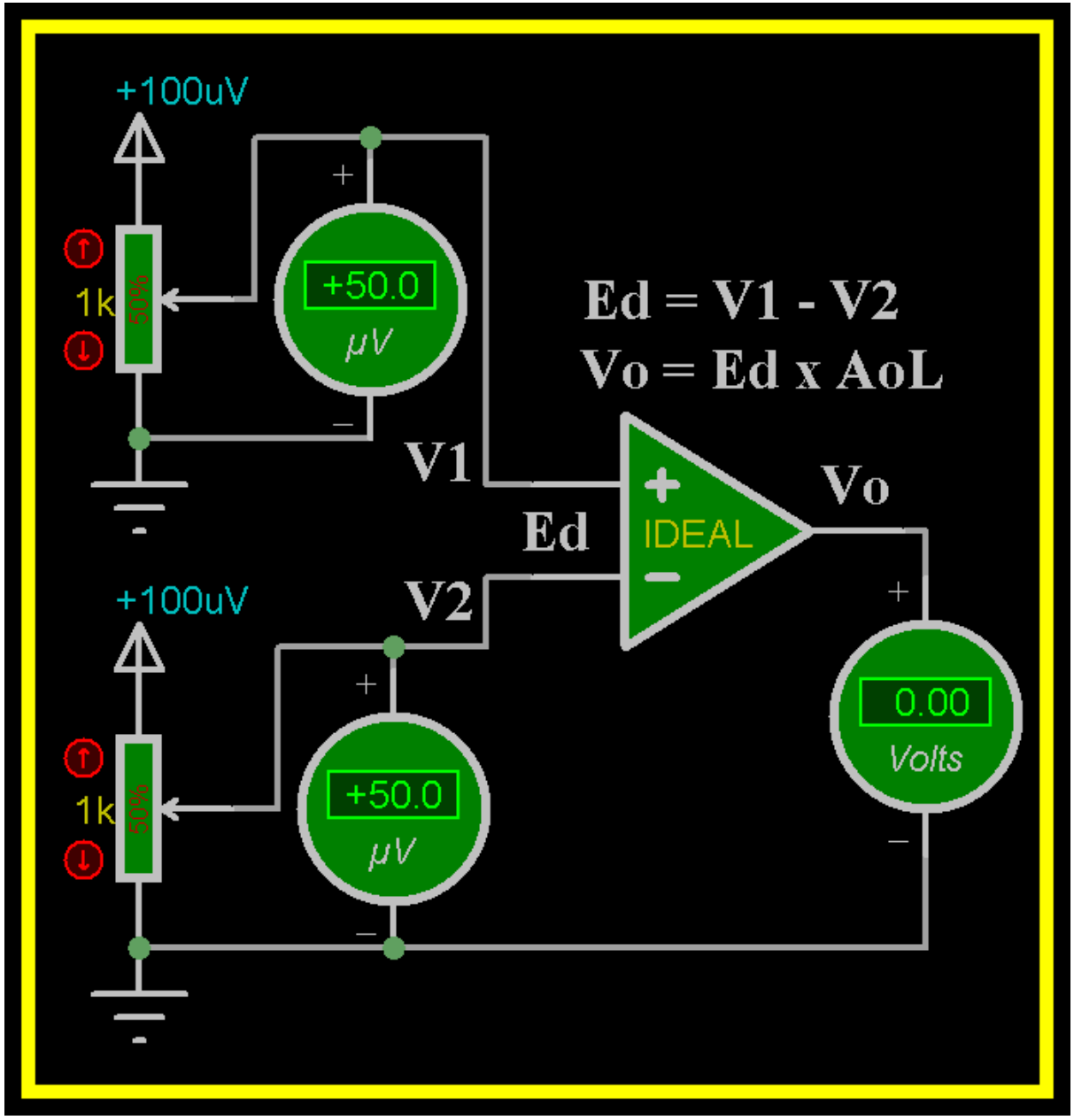
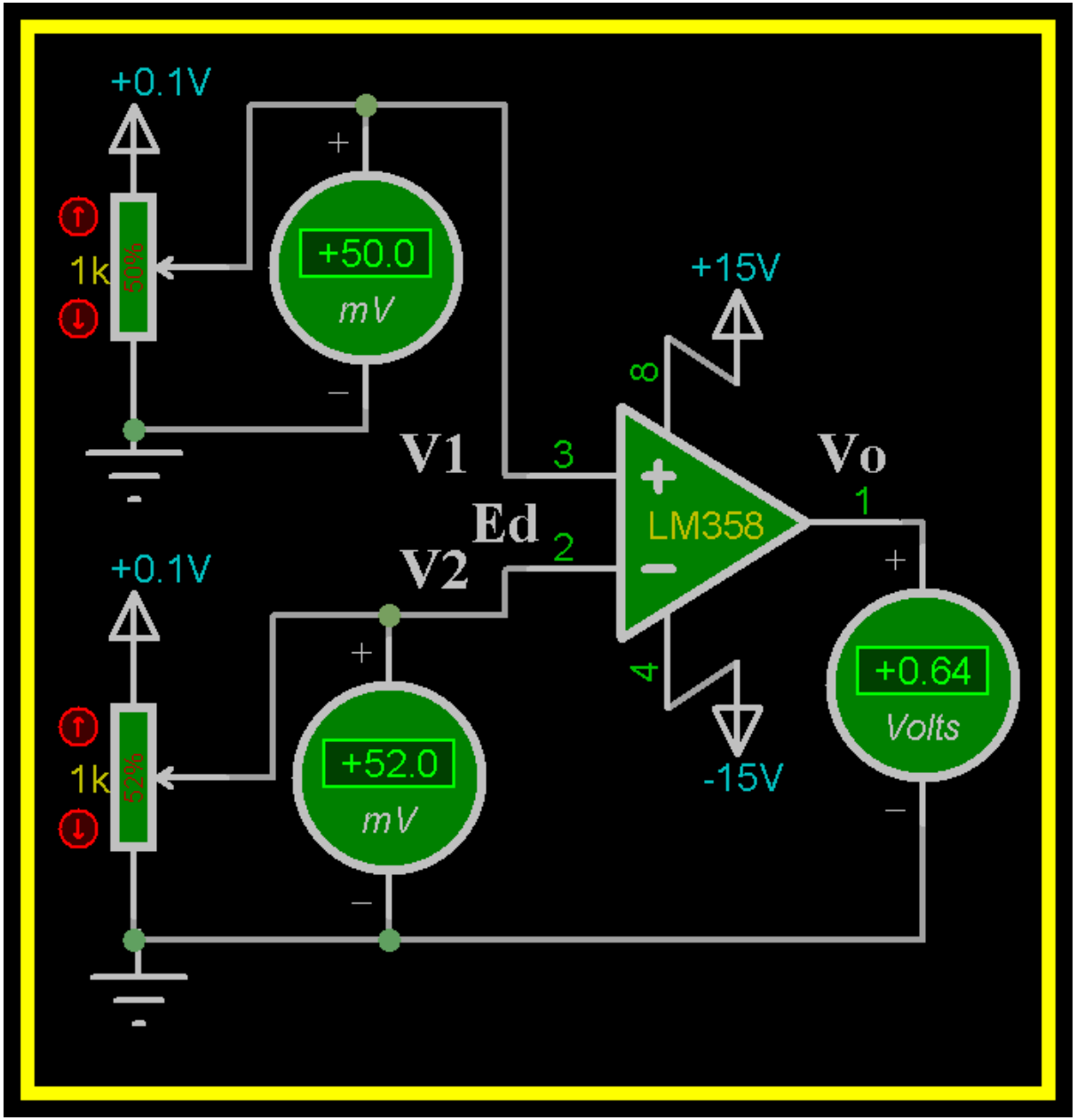
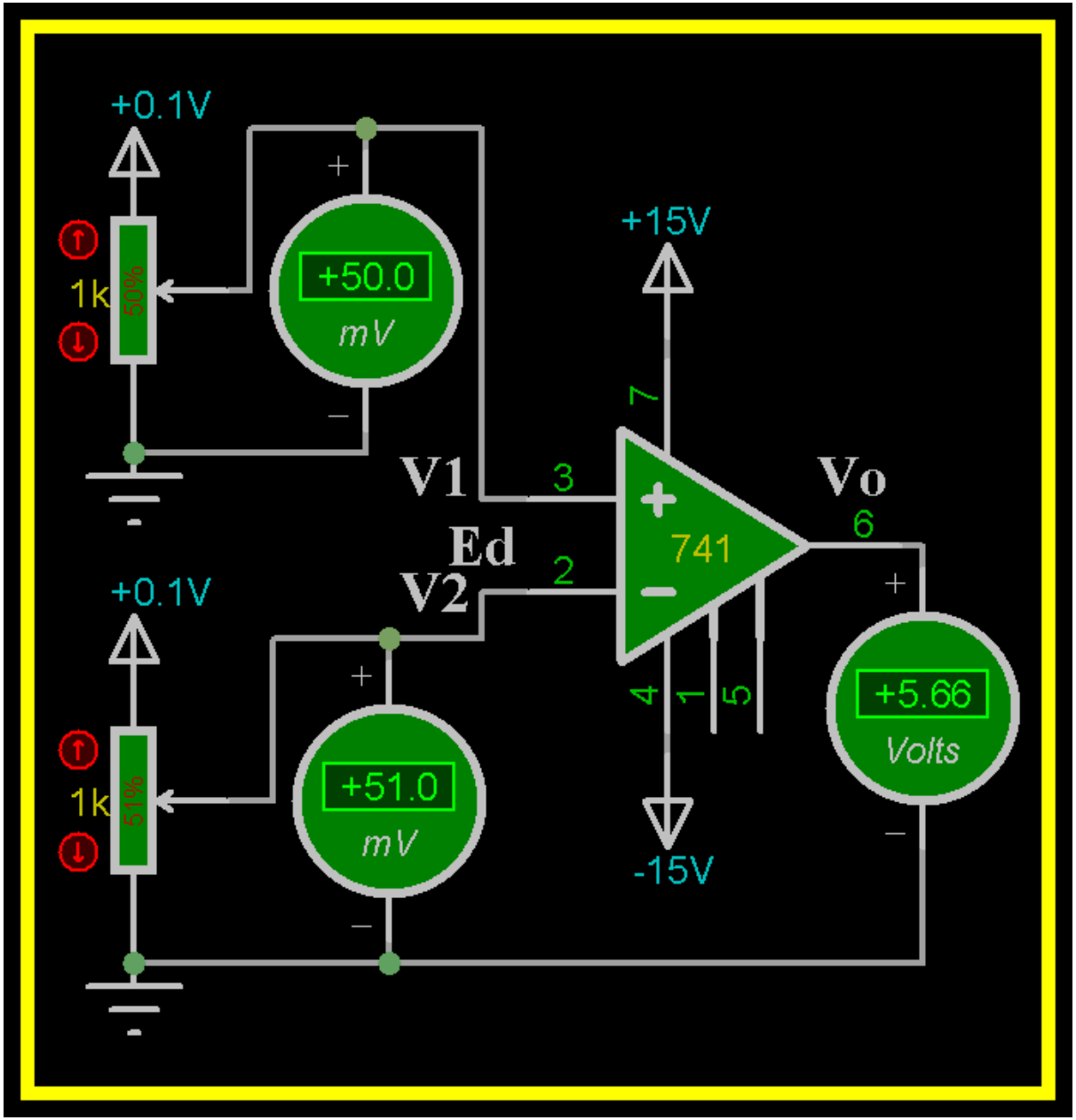
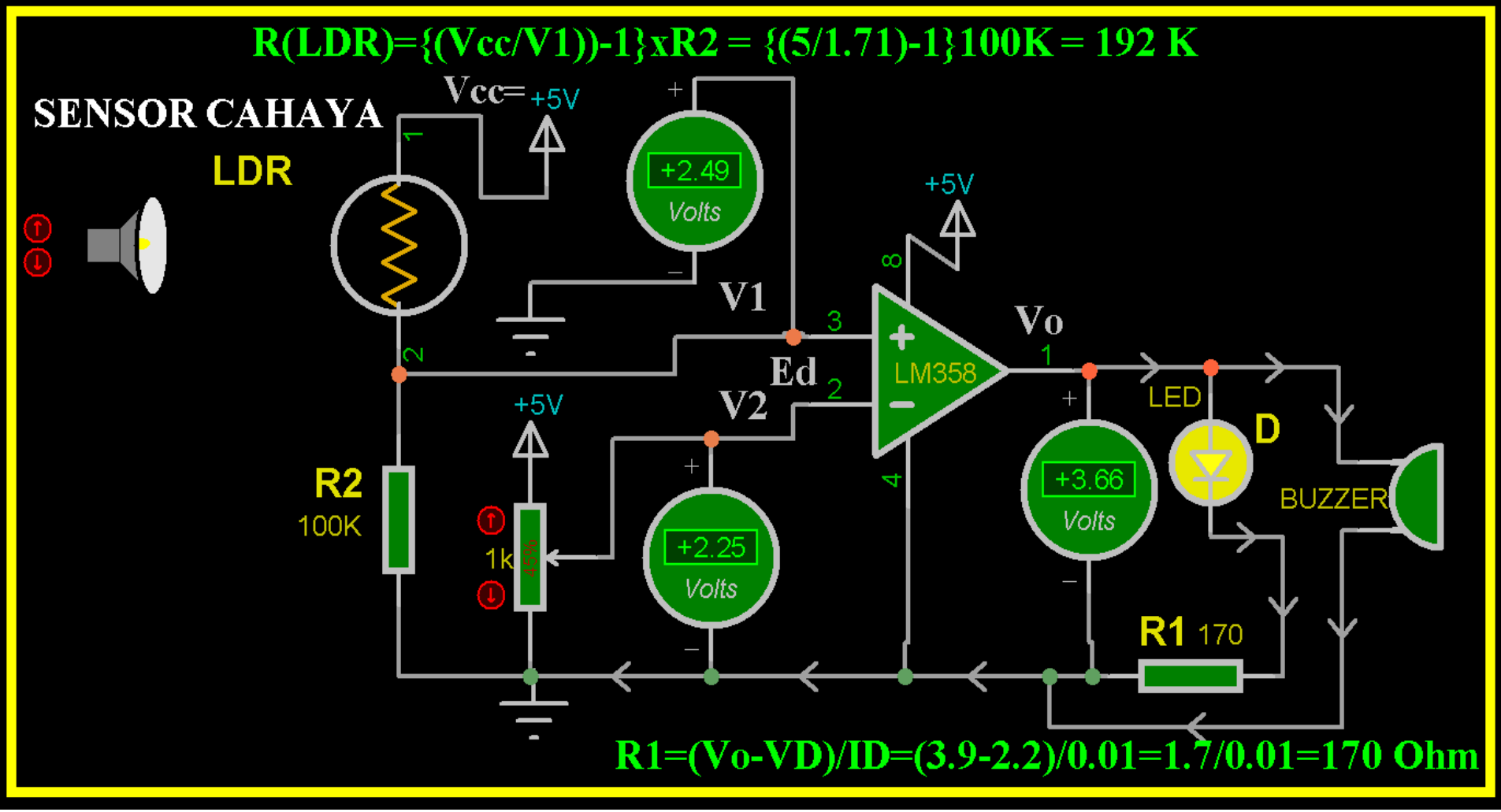
RANGKAIAN ANALOG

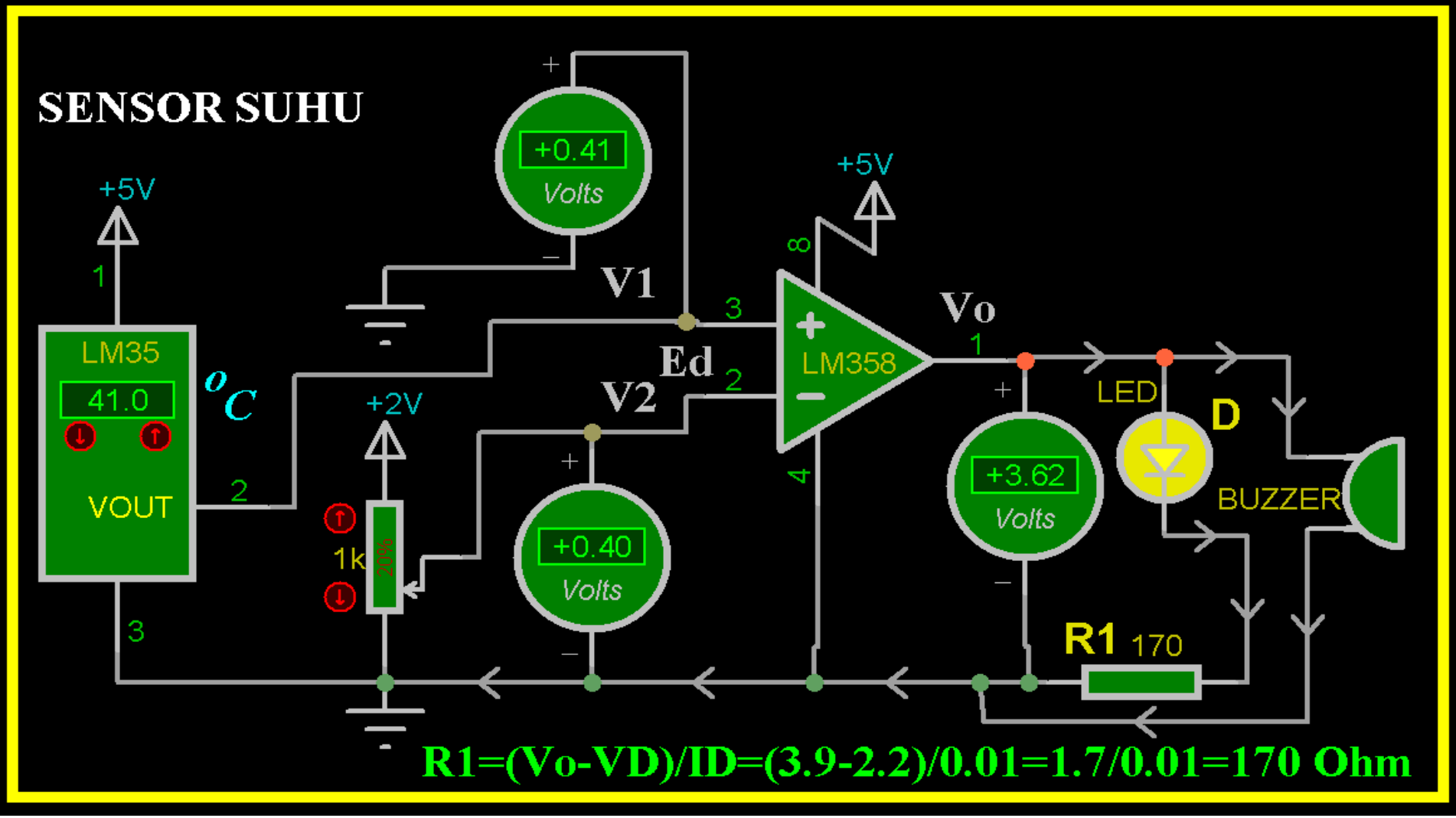


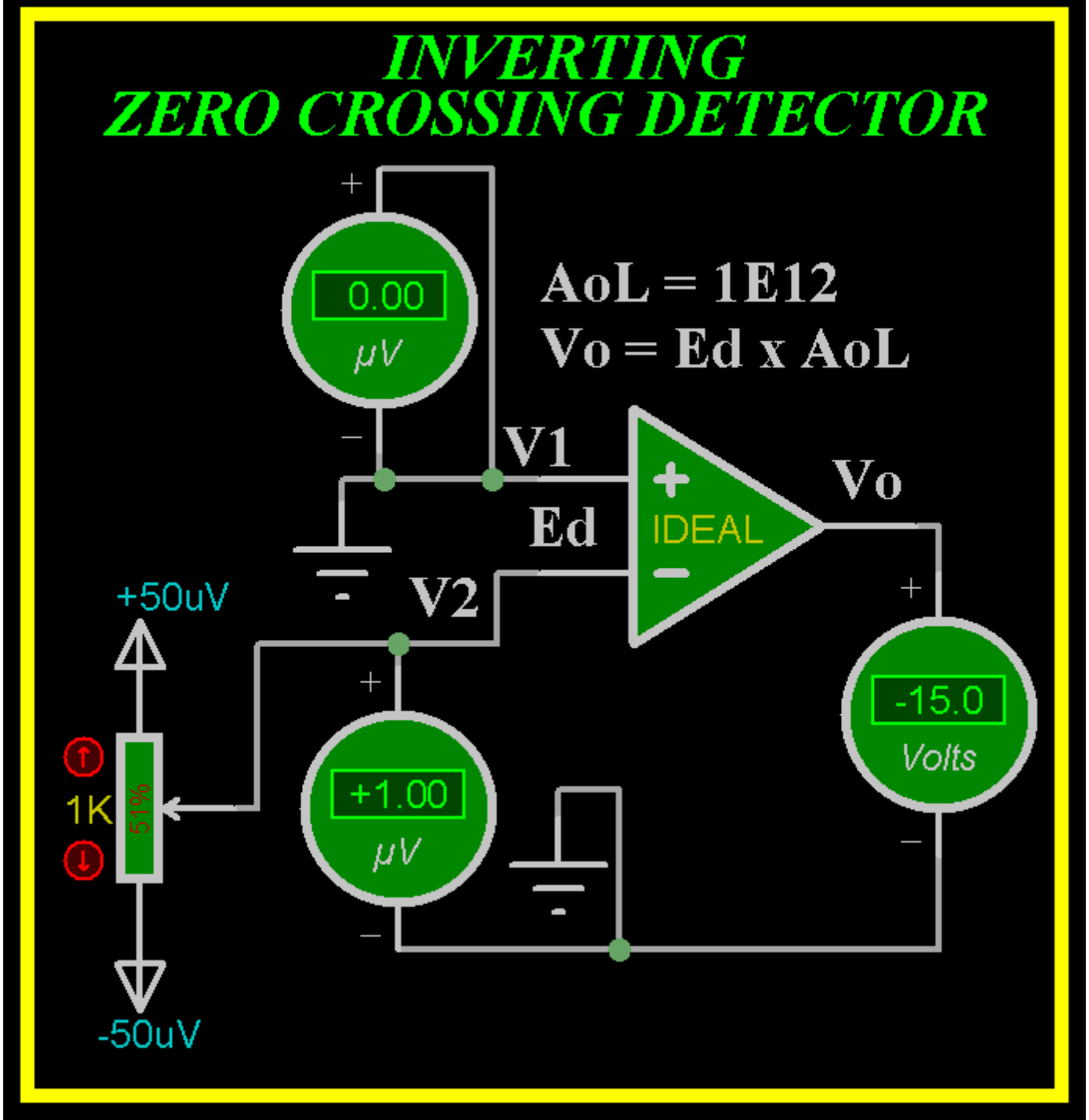

+100uV
1k
50%
+50.0
μV
Ed = V1 - V2
Vo = Ed x AoL
V1
Ed
V2
IDEAL
Vo
+100uV
1k
50%
+50.0
μV
0.00
Volts

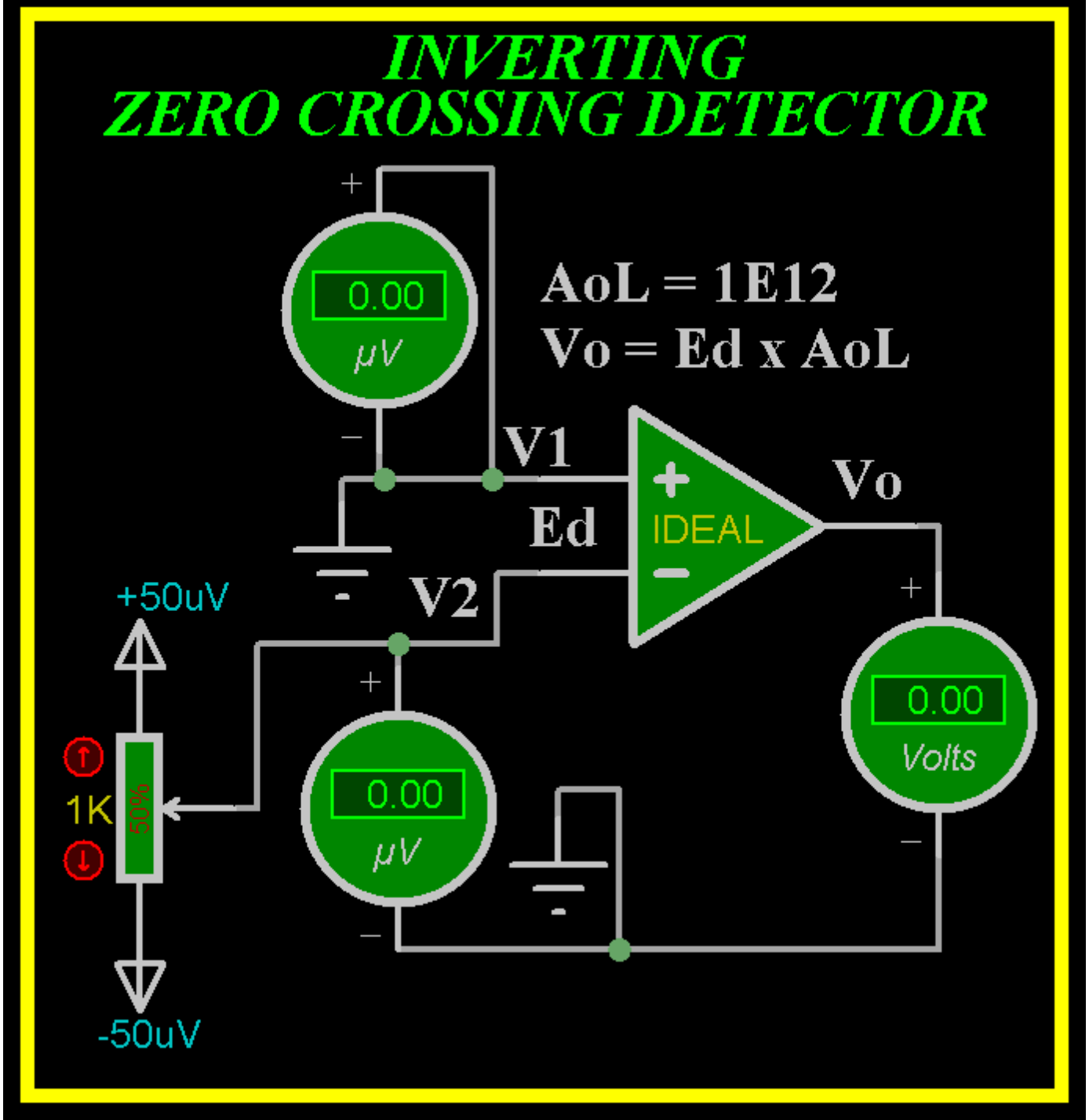

+0.1V
1k
50%
+50.0
mV
+15V
8
V1
3
Vo
Ed
1
LM358
2
V2
+0.1V
4
+0.64
Volts
1k
52%
+52.0
mV
-15V

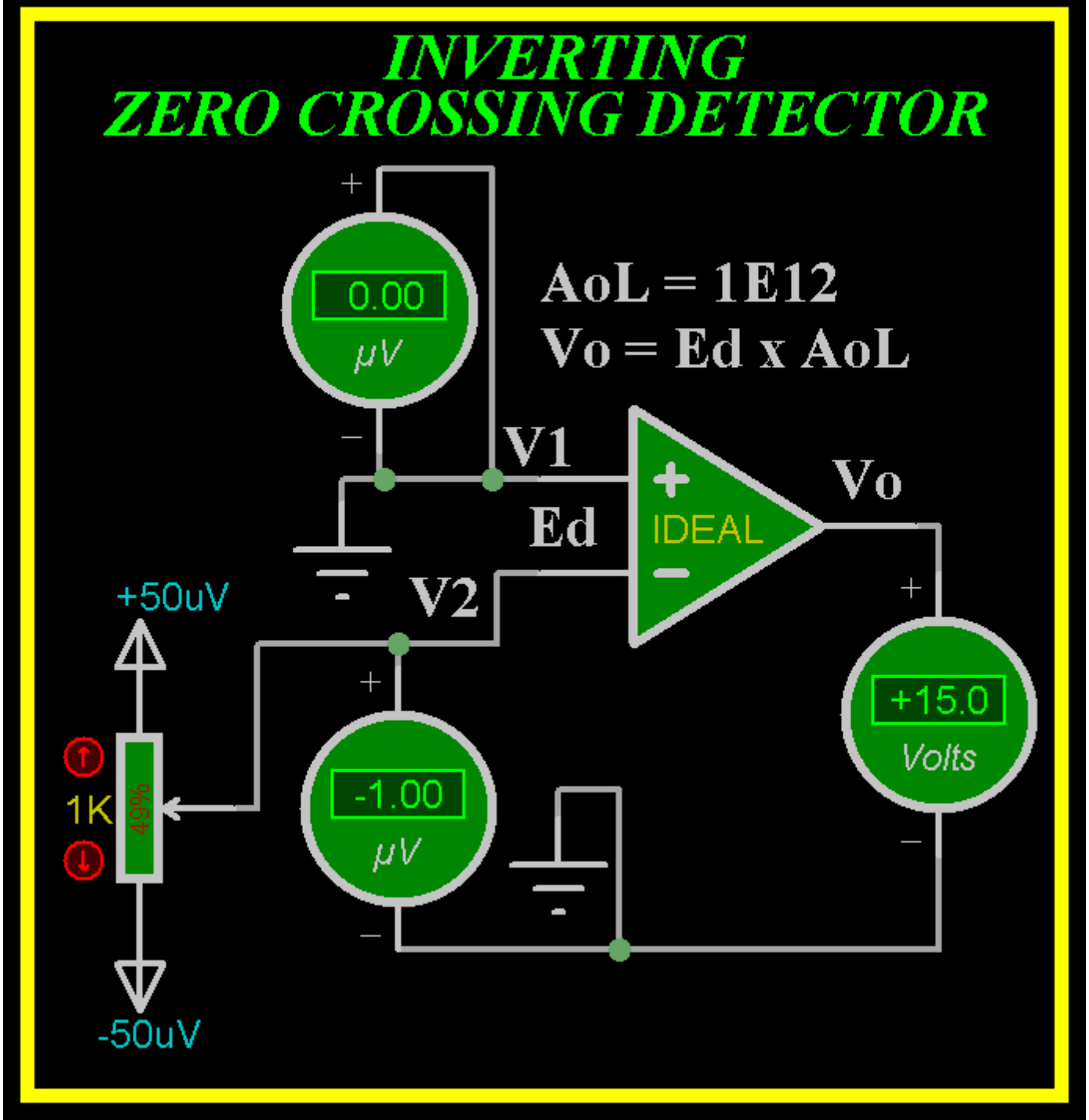

+0.1V
1k
50%
+50.0
mV
+15V
7
V1
3
Vo
6
Ed
V2
2
741
+0.1V
4
1
5
+5.66
Volts
1k
51%
+51.0
mV
-15V


R(LDR)={(Vcc/V1))-1}xR2 = {(5/1.71)-1}100K = 192 K
SENSOR CAHAYA
LDR
Vcc=
+5V
+2.49
Volts
V1
+5V
Vo
Ed
V2
LM358
+5V
LED
D
R2
100K
1k
+2.25
Volts
+3.66
Volts
BUZZER
R1 170
R1=(Vo-VD)/ID=(3.9-2.2)/0.01=1.7/0.01=170 Ohm

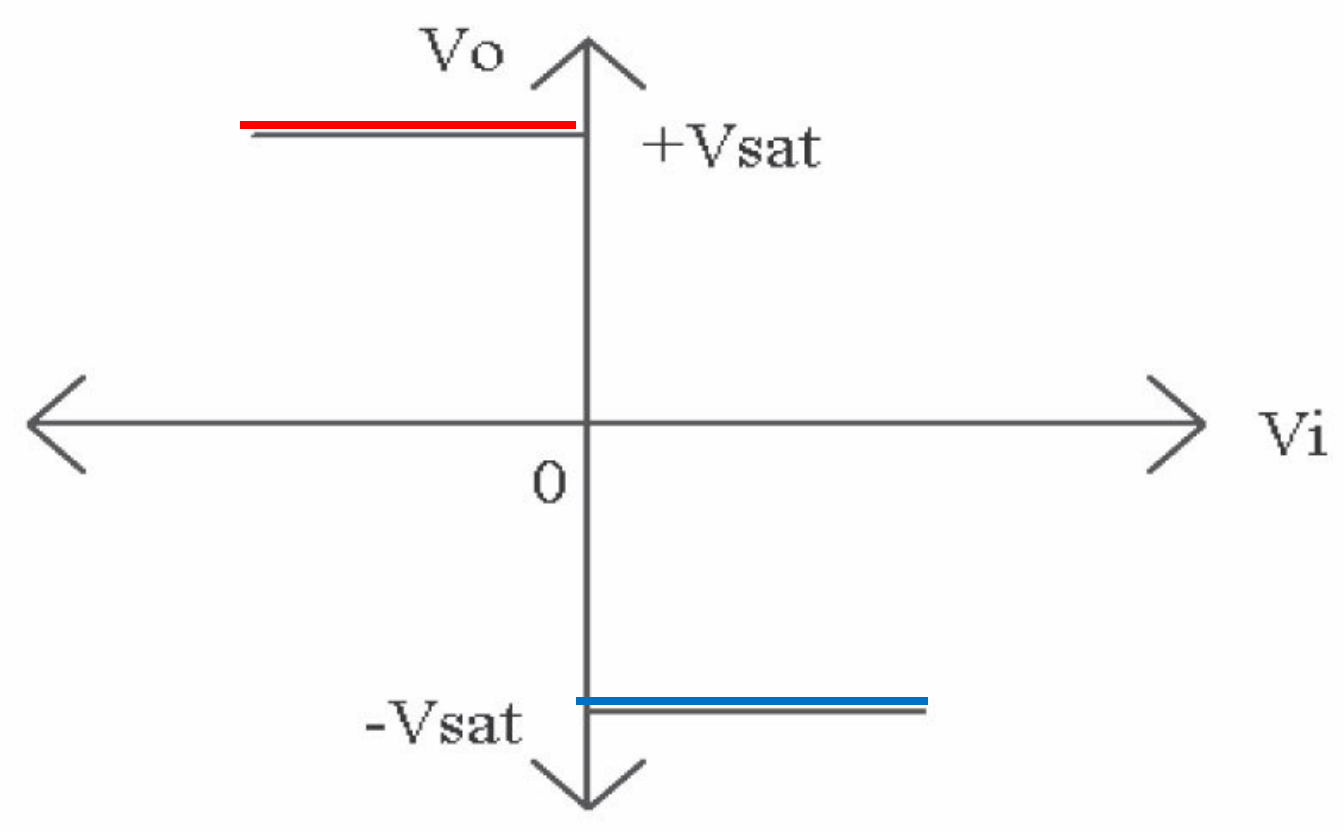

SENSOR SUHU
+5V
1
LM35
41.0
VOUT
2
3
°C
+0.41
Volts
V1
+2V
1k
20%
+0.40
Volts
V2
Ed
3
2
+5V
8
LM358
4
Vo
1
+3.62
Volts
LED
D
BUZZER
R1 170
R1=(Vo-VD)/ID=(3.9-2.2)/0.01=1.7/0.01=170 Ohm


INVERTING
ZERO CROSSING DETECTOR
0.00
μV
AoL = 1E12
Vo = Ed x AoL
V1
Ed
IDEAL
Vo
V2
+50uV
1K
51%
+1.00
μV
-15.0
Volts
-50uV

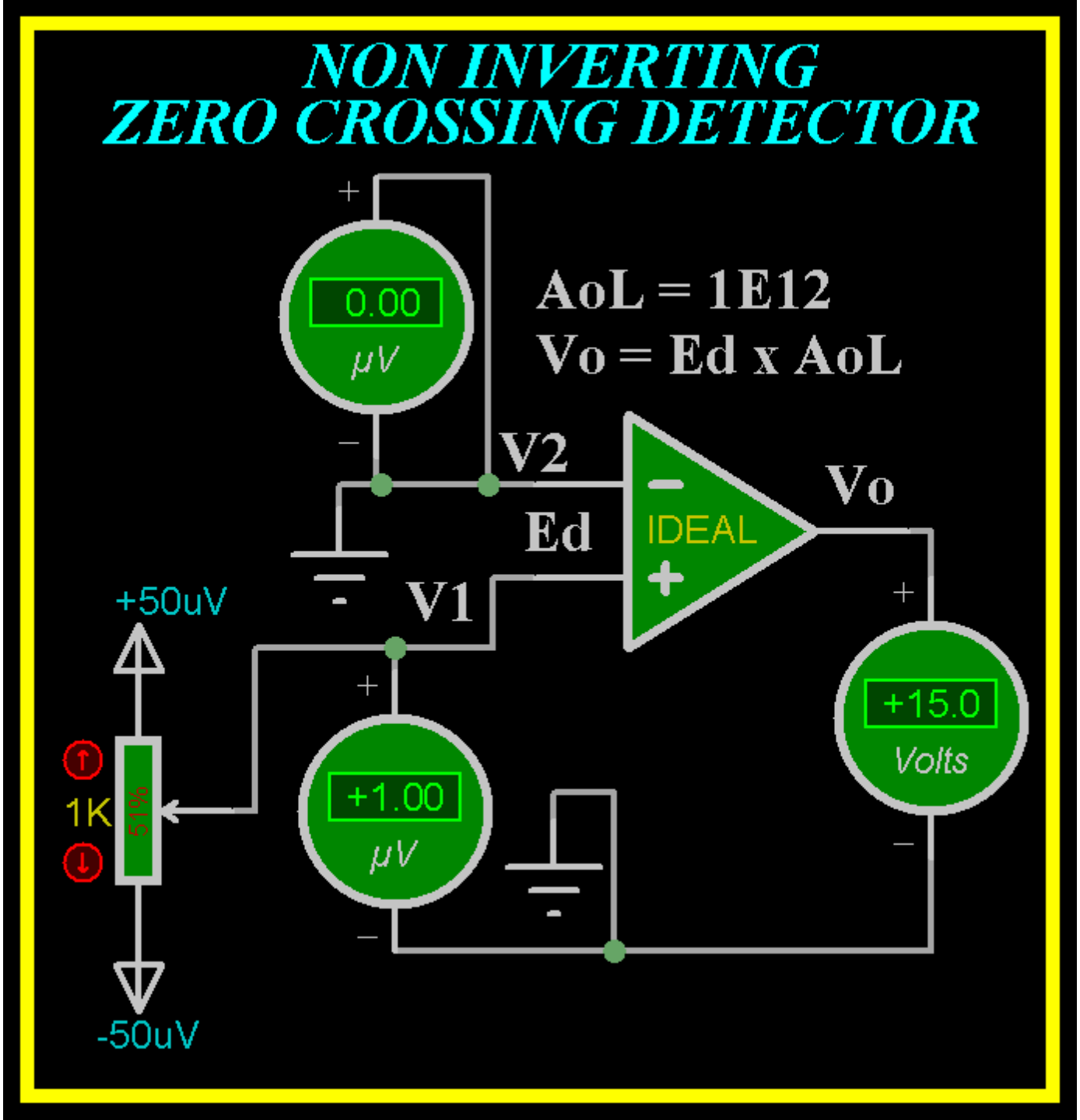

INVERTING
ZERO CROSSING DETECTOR
AoL = 1E12
Vo = Ed x AoL
0.00
μV
V1
Ed
V2
IDEAL
Vo
+50uV
-50uV
1K
50%
0.00
μV
0.00
Volts

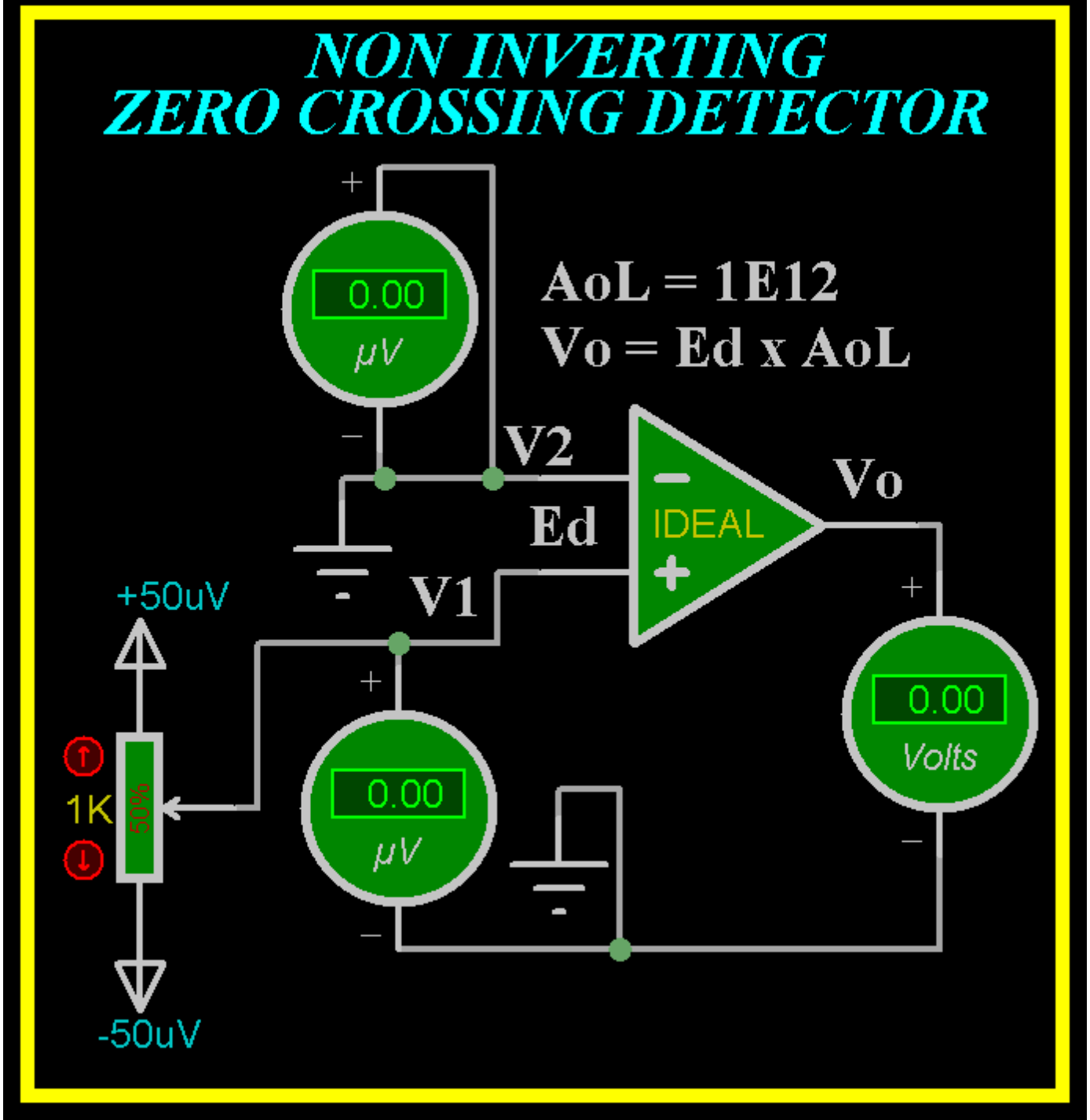

INVERTING
ZERO CROSSING DETECTOR
0.00
μV
AoL = 1E12
Vo = Ed x AoL
V1
Ed
V2
IDEAL
Vo
+50uV
-50uV
1K
49%
-1.00
μV
+15.0
Volts

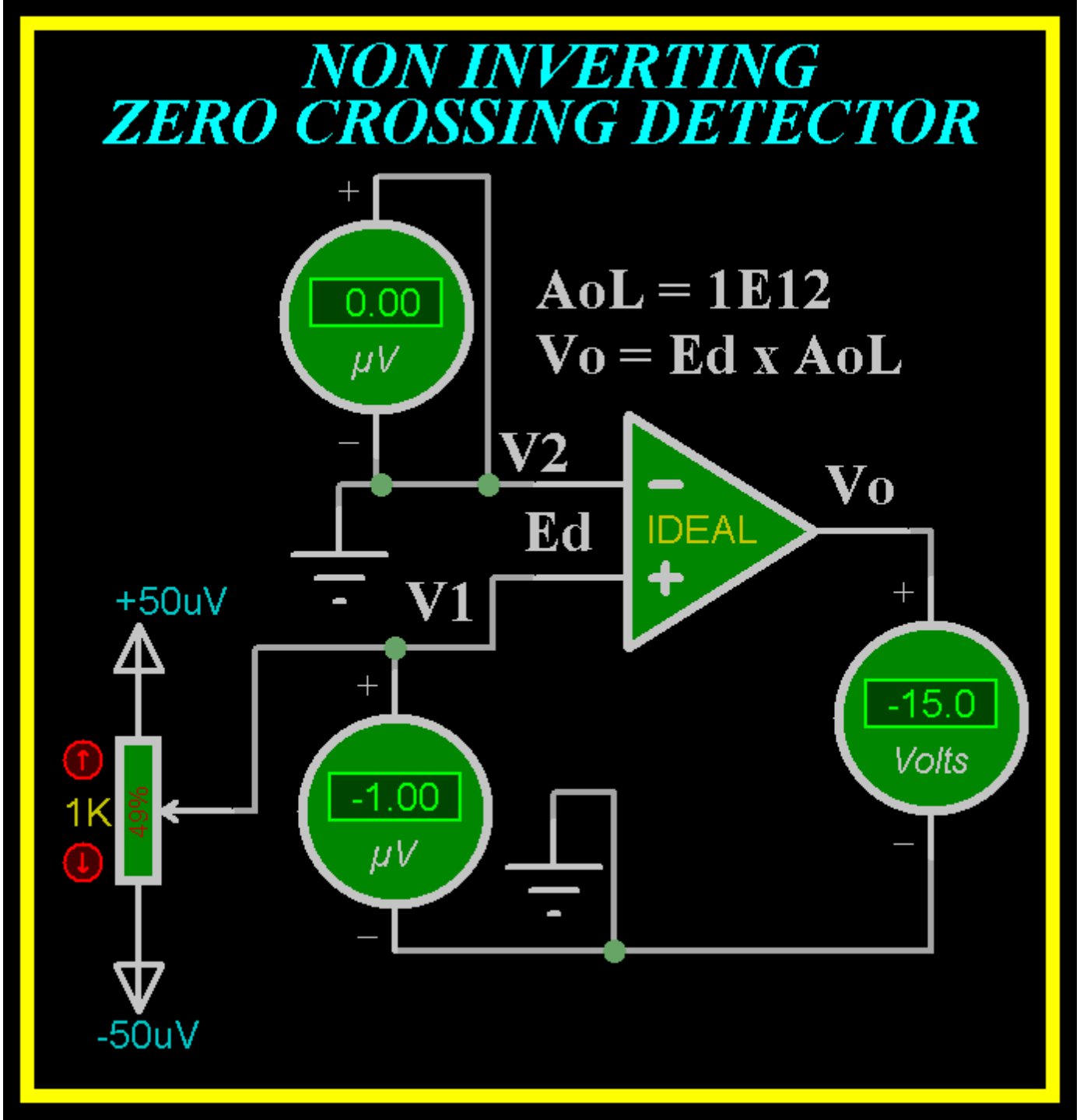
INVERTING ZERO CROSSING DETECTOR (IZCD)



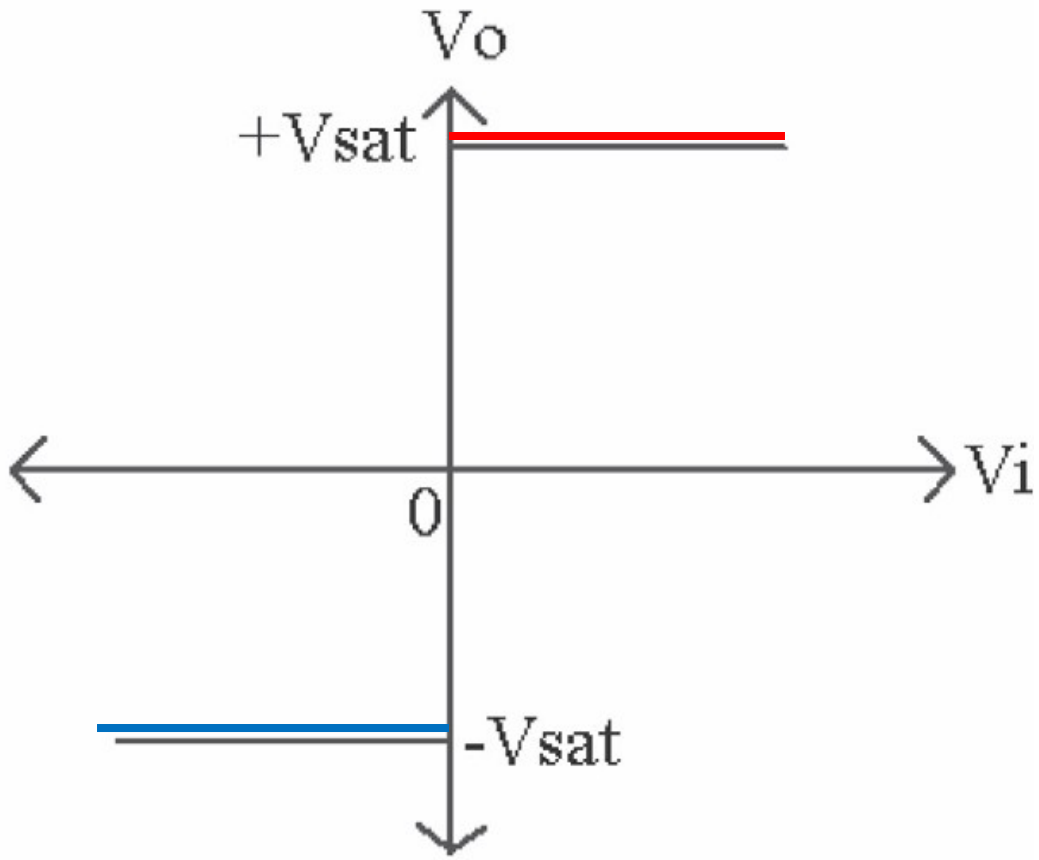
KARAKTERISTIK *INPUT-OUTPUT IZCD*


NON INVERTING
ZERO CROSSING DETECTOR
AoL = 1E12
Vo = Ed x AoL
0.00
μV
V2
Ed
V1
IDEAL
Vo
+50uV
-50uV
1K
51%
+1.00
μV
+15.0
Volts

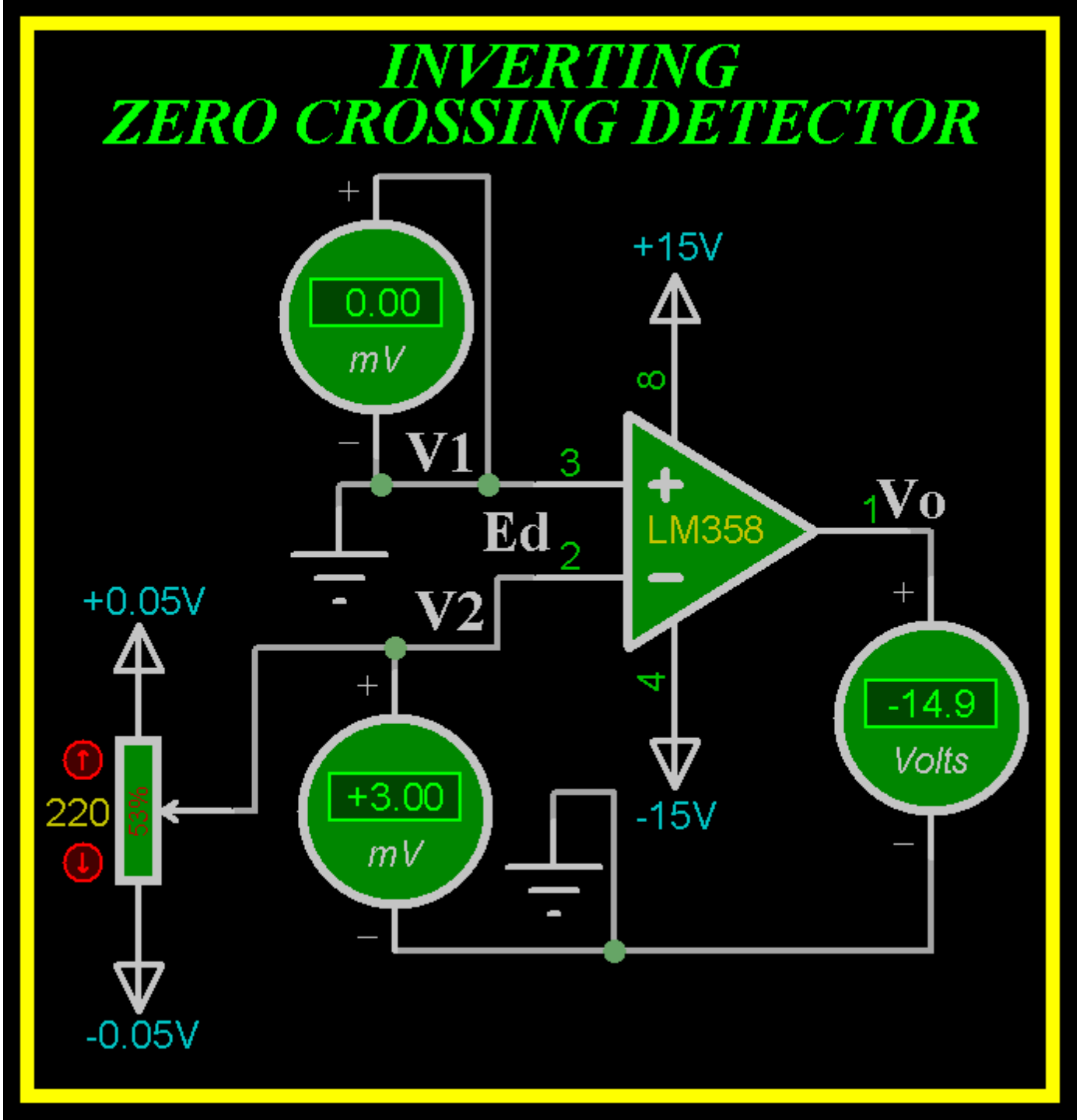

NON INVERTING
ZERO CROSSING DETECTOR
AoL = 1E12
Vo = Ed x AoL
0.00
μV
V2
Ed
V1
IDEAL
Vo
+50uV
-50uV
1K
50%
0.00
μV
0.00
Volts

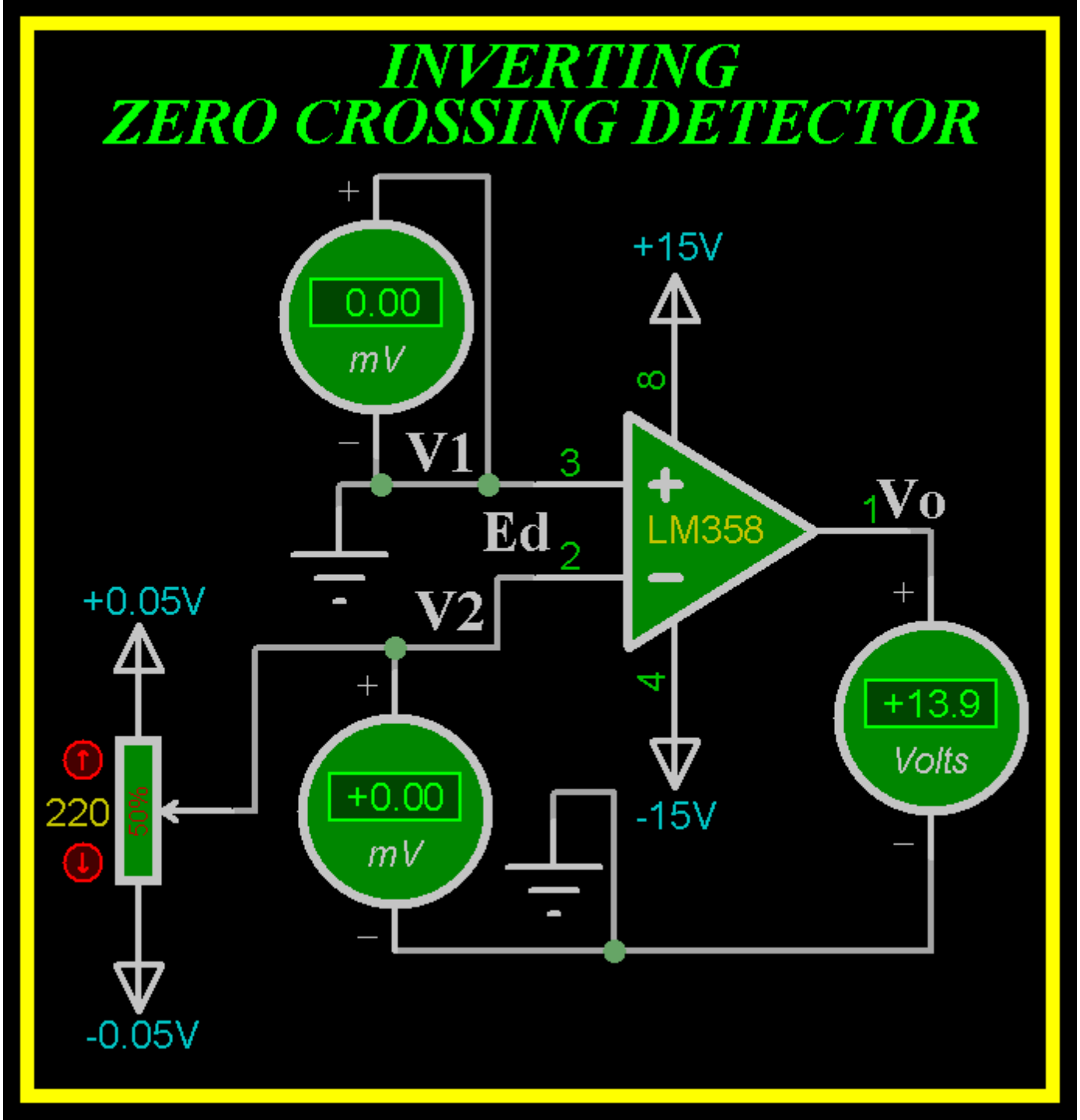

NON INVERTING
ZERO CROSSING DETECTOR
AoL = 1E12
Vo = Ed x AoL
0.00
μV
V2
Ed
V1
IDEAL
Vo
+50uV
1K
49%
-50uV
-1.00
μV
-15.0
Volts

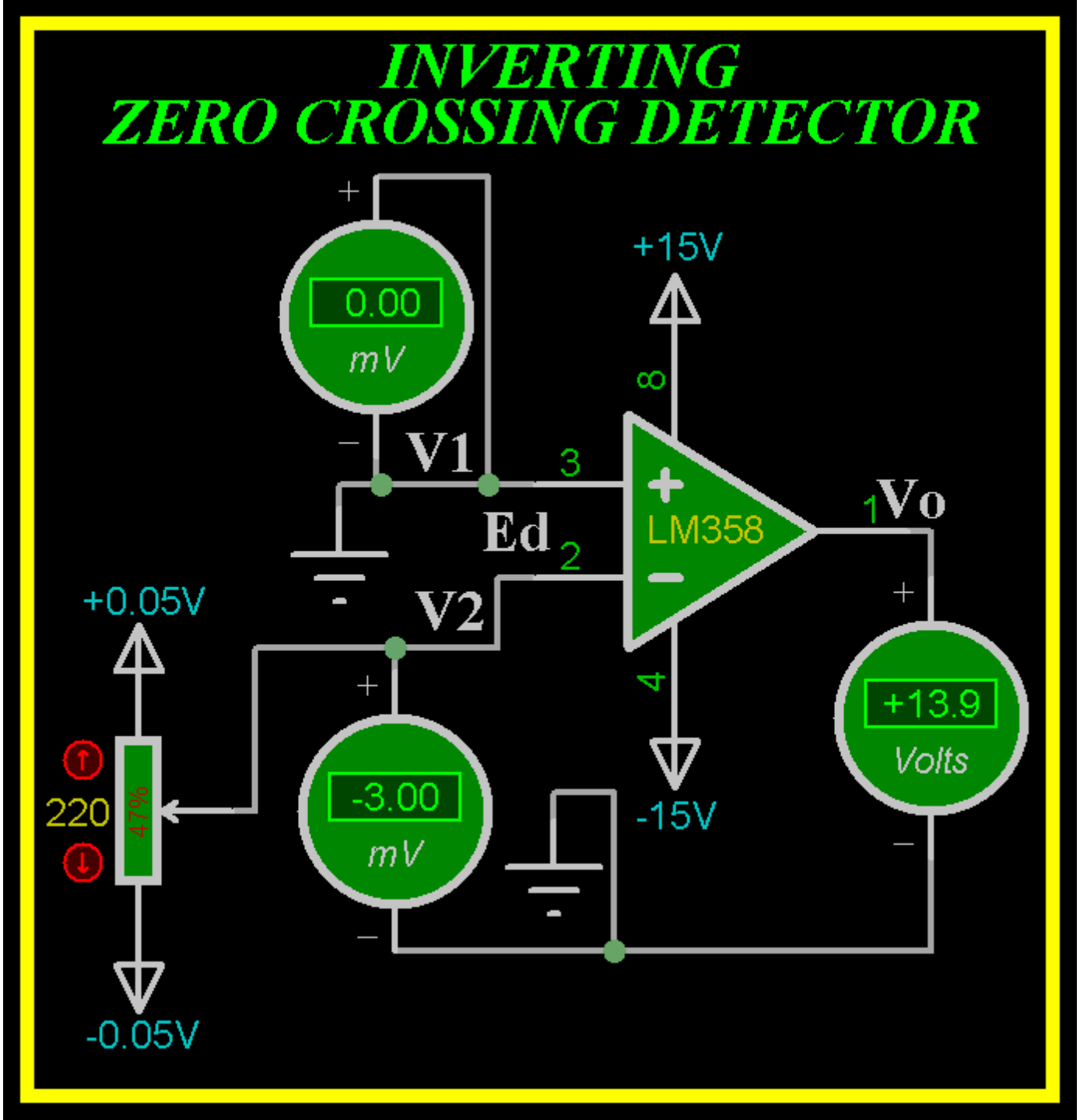
NON INVERTING ZERO CROSSING DETECTOR

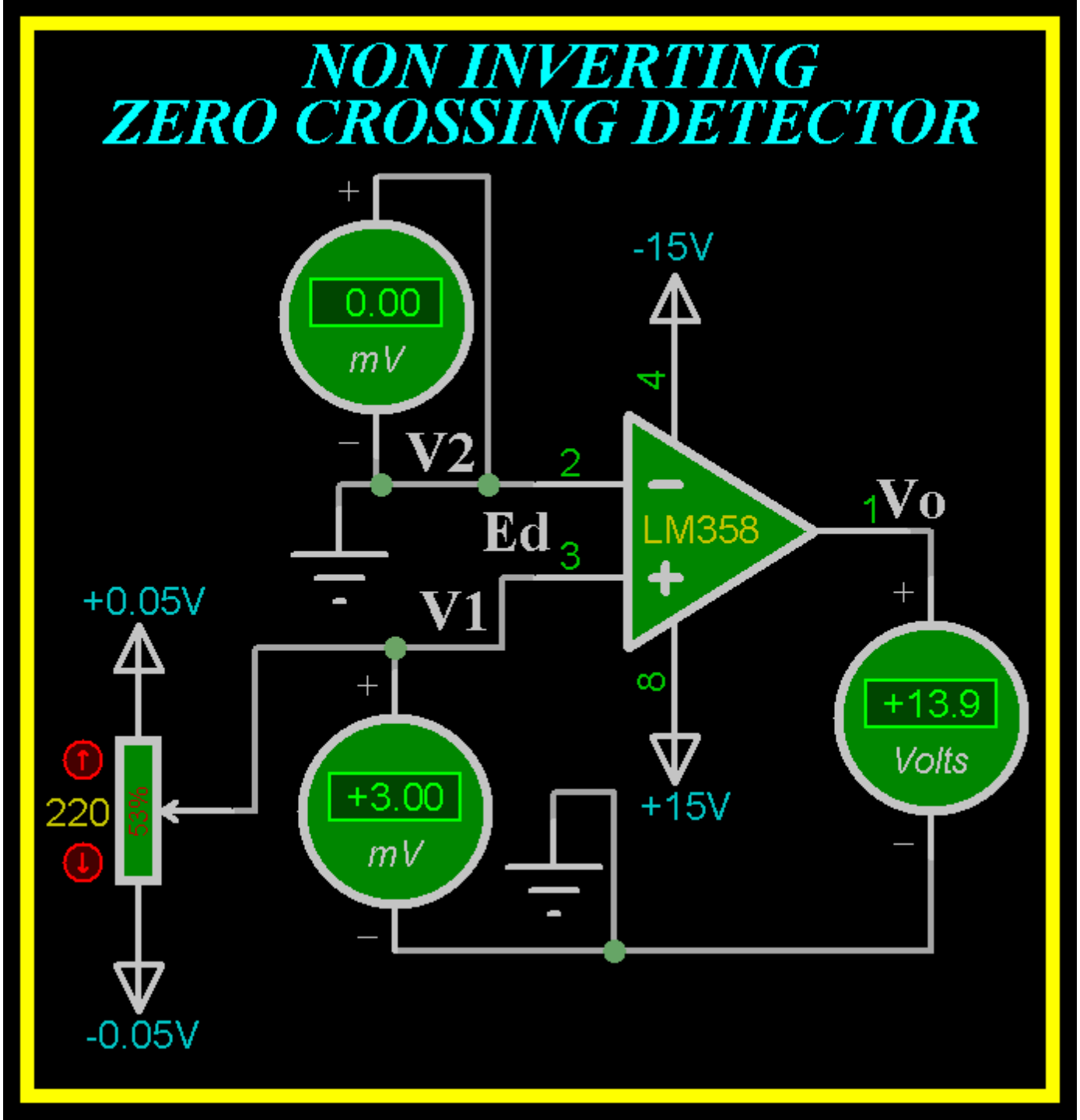


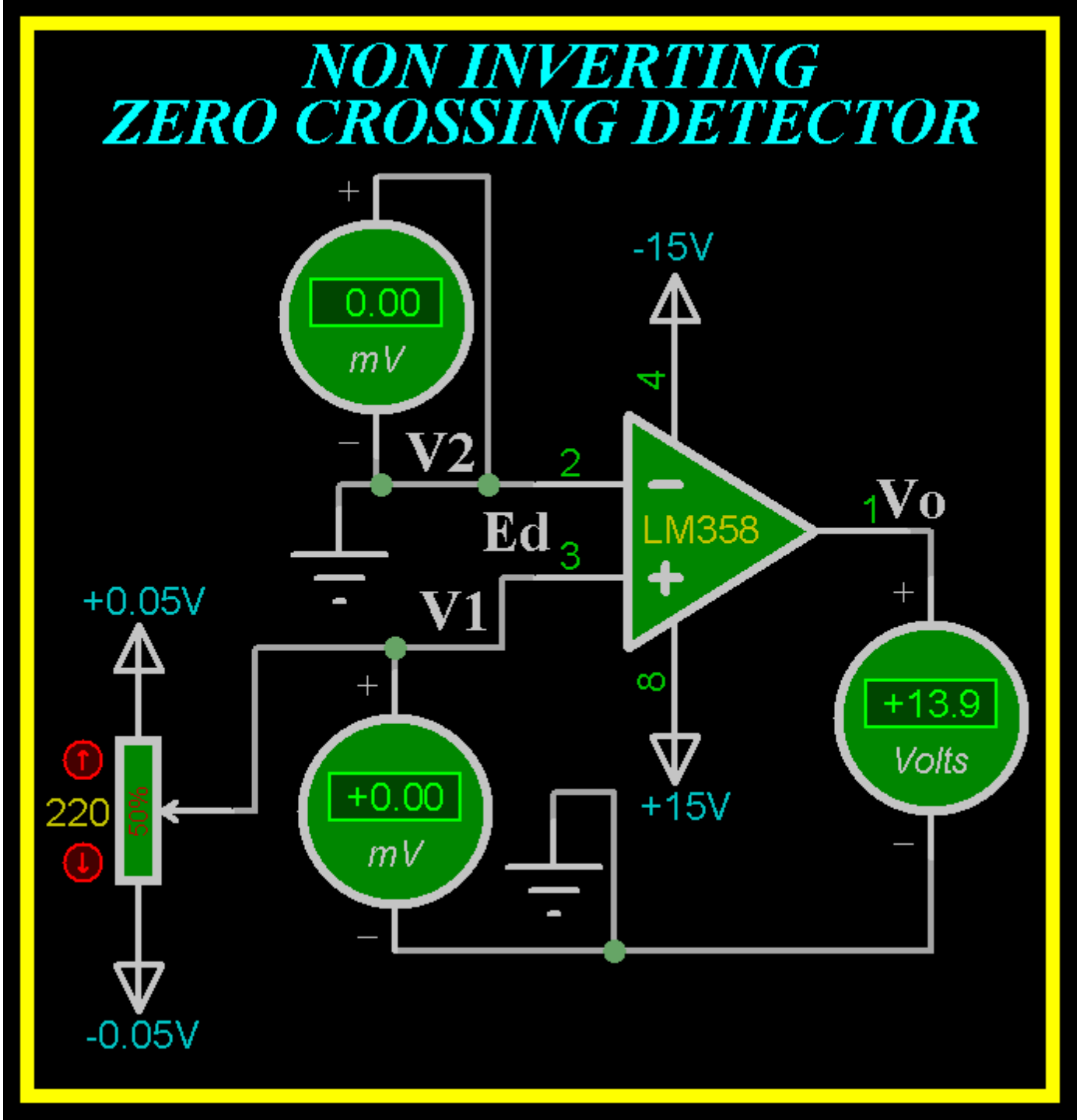
KARAKTERISTIK *INPUT-OUTPUT NIZCD*

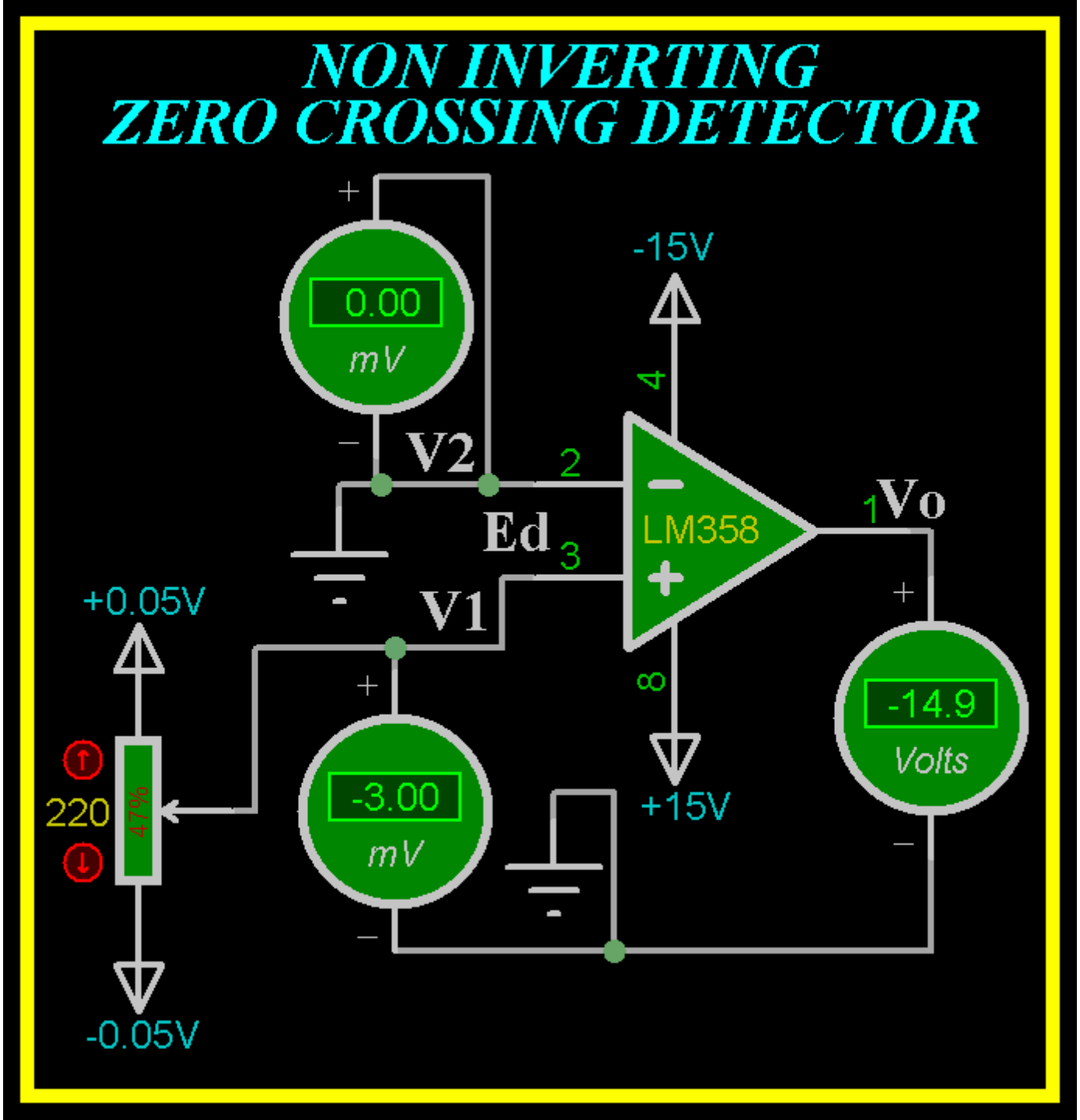

INVERTING
ZERO CROSSING DETECTOR
+
0.00
mV
−
V1
+15V
8
3
+
LM358
−
1Vo
Ed
2
V2
+0.05V
+
+3.00
mV
−
4
-15V
+
-14.9
Volts
−
220
53%
-0.05V


INVERTING
ZERO CROSSING DETECTOR
+
0.00
mV
−
V1
3
+15V
8
+
LM358
−
1Vo
Ed
2
V2
+0.05V
+
+0.00
mV
−
4
-15V
+
+13.9
Volts
−
220
50%
-0.05V

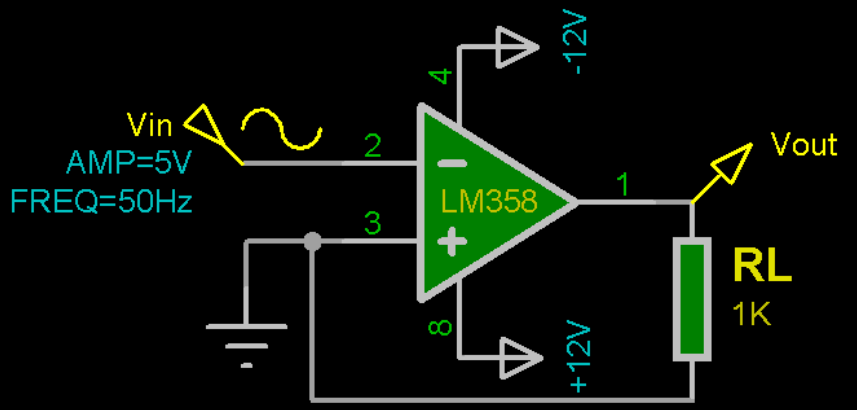

INVERTING
ZERO CROSSING DETECTOR
+
0.00
mV
−
V1
3
+15V
8
+
LM358
−
1Vo
Ed
2
V2
+0.05V
+
+13.9
Volts
−
4
+
-3.00
mV
−
220
47%
-15V
-0.05V

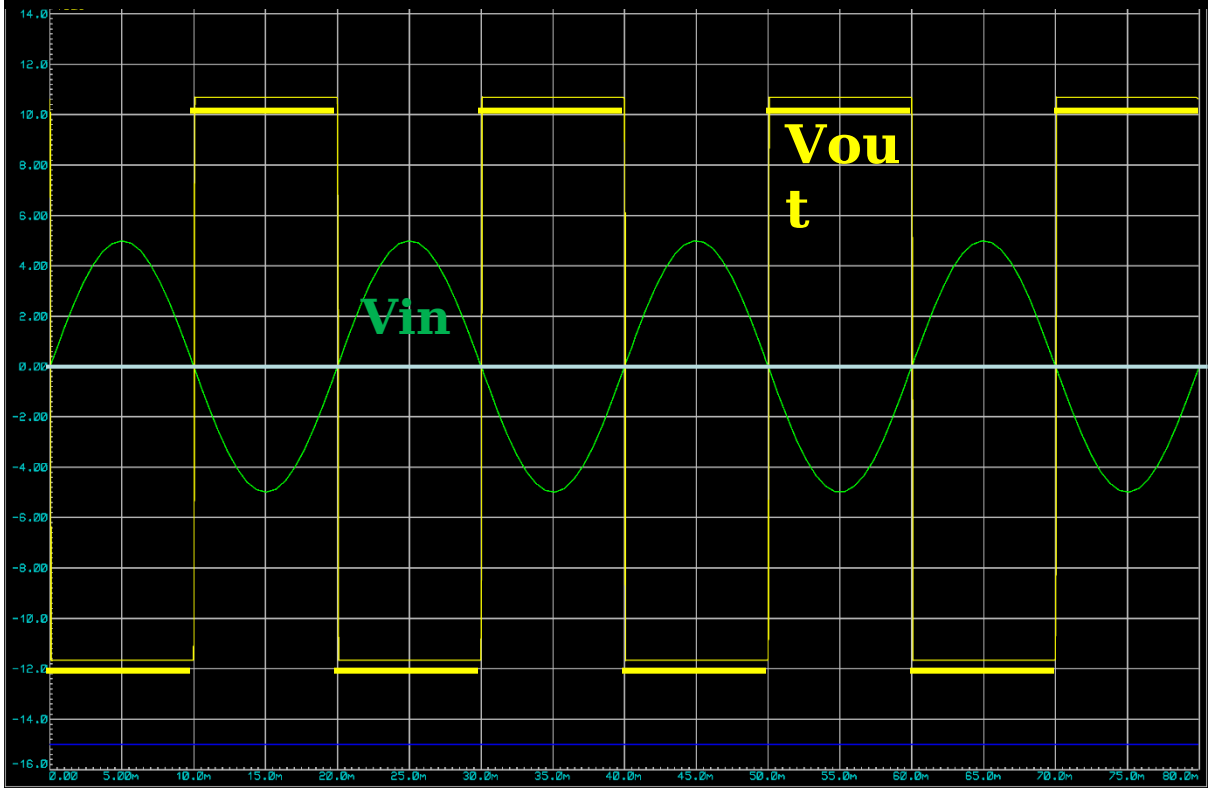

NON INVERTING
ZERO CROSSING DETECTOR
0.00
mV
V2
-15V
4
2
LM358
1Vo
Ed
3
V1
+0.05V
+13.9
Volts
8
+3.00
mV
+15V
220
53%
-0.05V


NON INVERTING
ZERO CROSSING DETECTOR
0.00
mV
V2
-15V
4
2
LM358
1Vo
Ed
3
V1
+0.05V
+13.9
Volts
+0.00
mV
220
50%
+15V
-0.05V

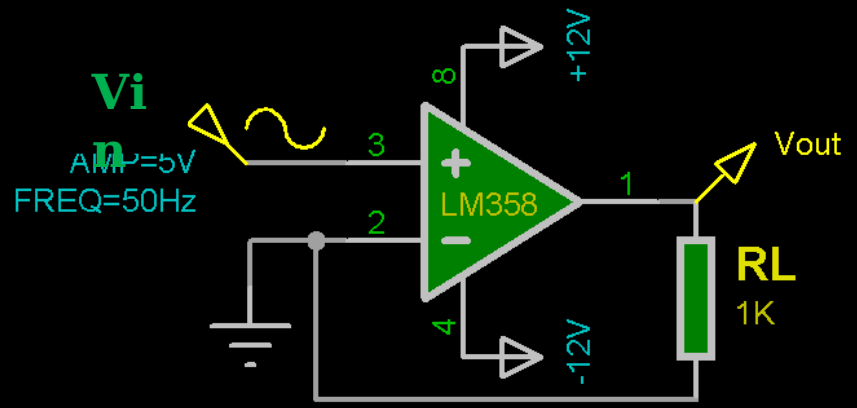

NON INVERTING
ZERO CROSSING DETECTOR
0.00
mV
V2
2
-15V
4
LM358
1Vo
Ed
3
V1
+0.05V
8
-14.9
Volts
220
47%
-3.00
mV
+15V
-0.05V

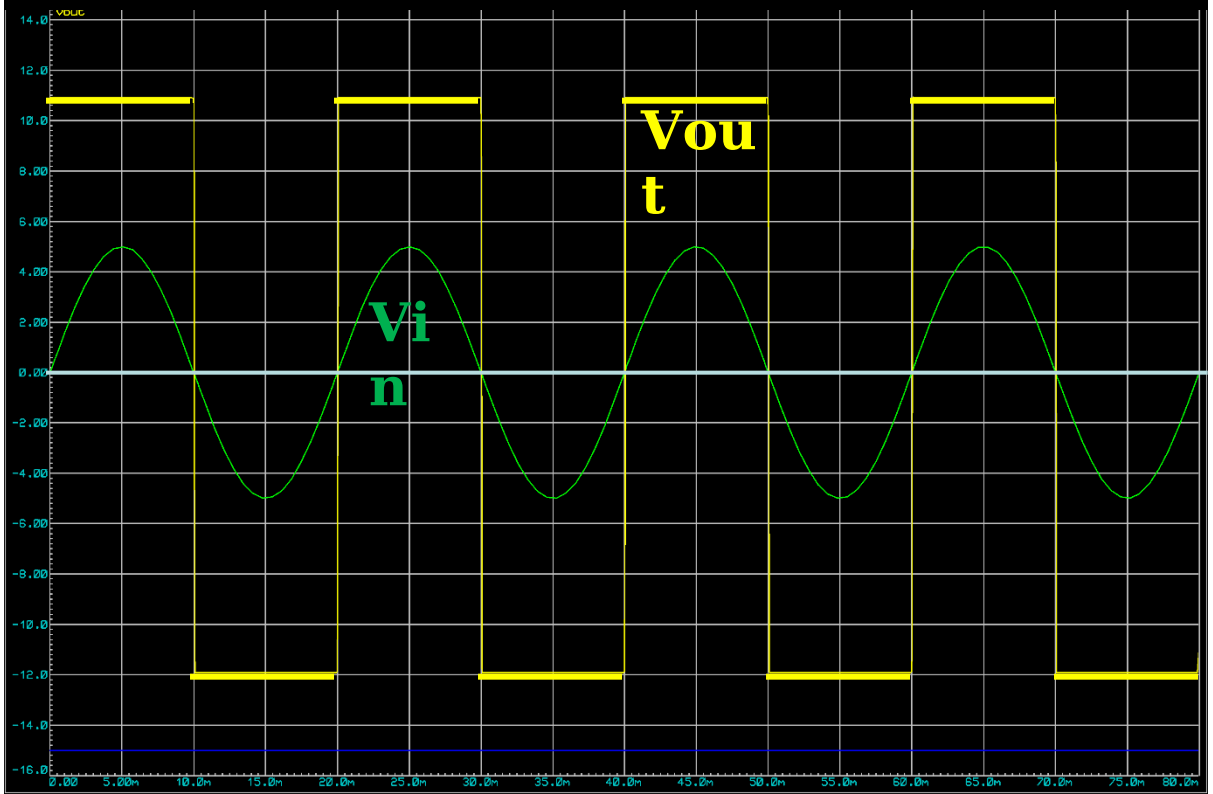
INVERTING ZERO CROSSING DETECTOR
IZCD



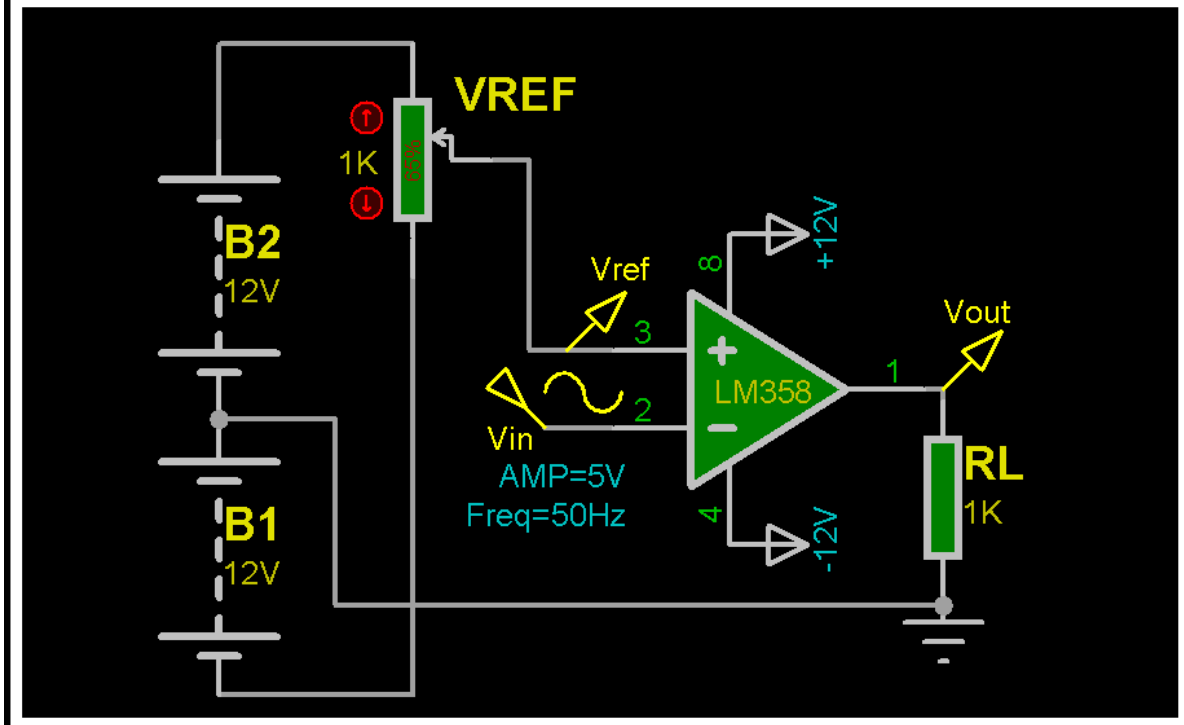


NON-INVERTING ZERO CROSSING DETECTOR
NIZCD

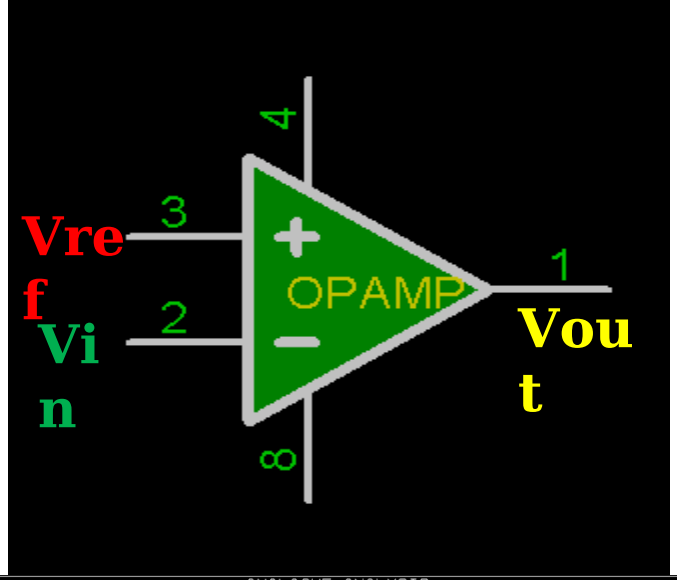




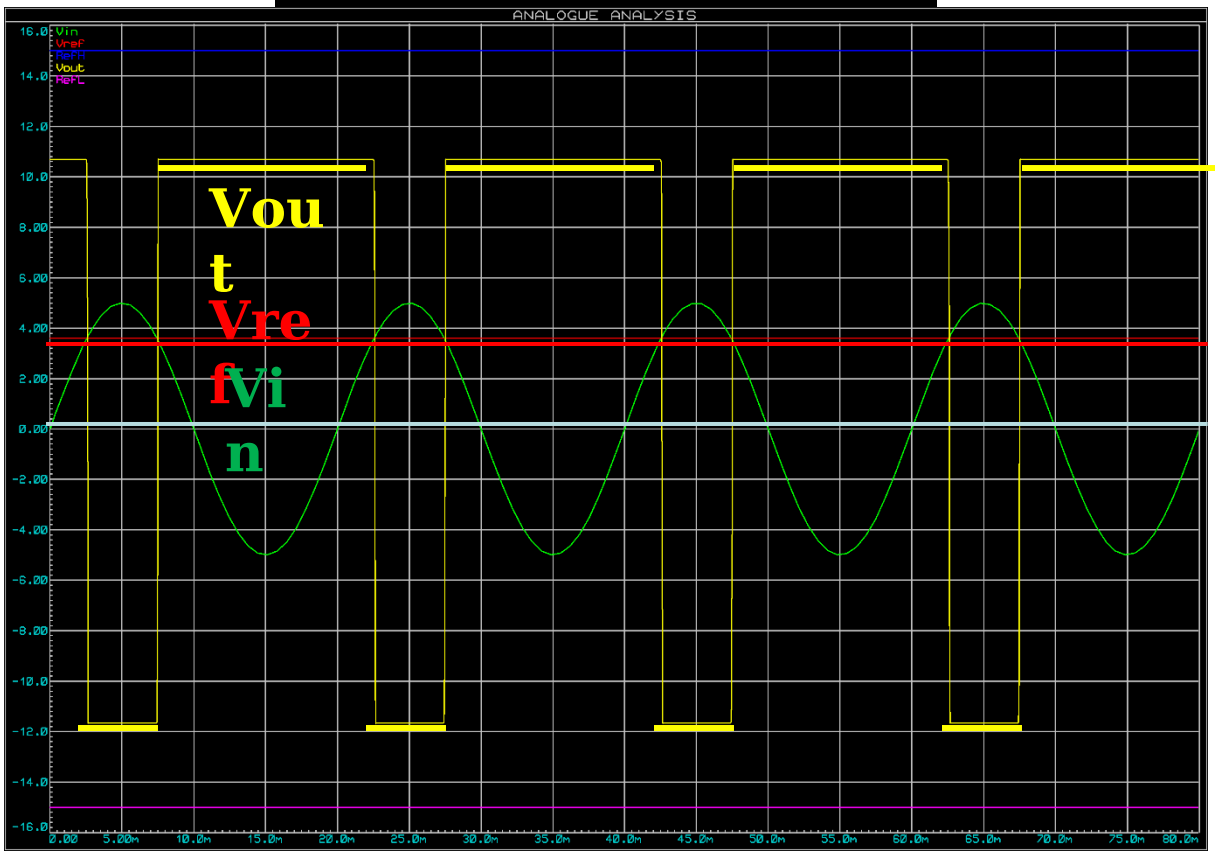
INVERTING VOLTAGE LEVEL DETECTOR (IVLD)



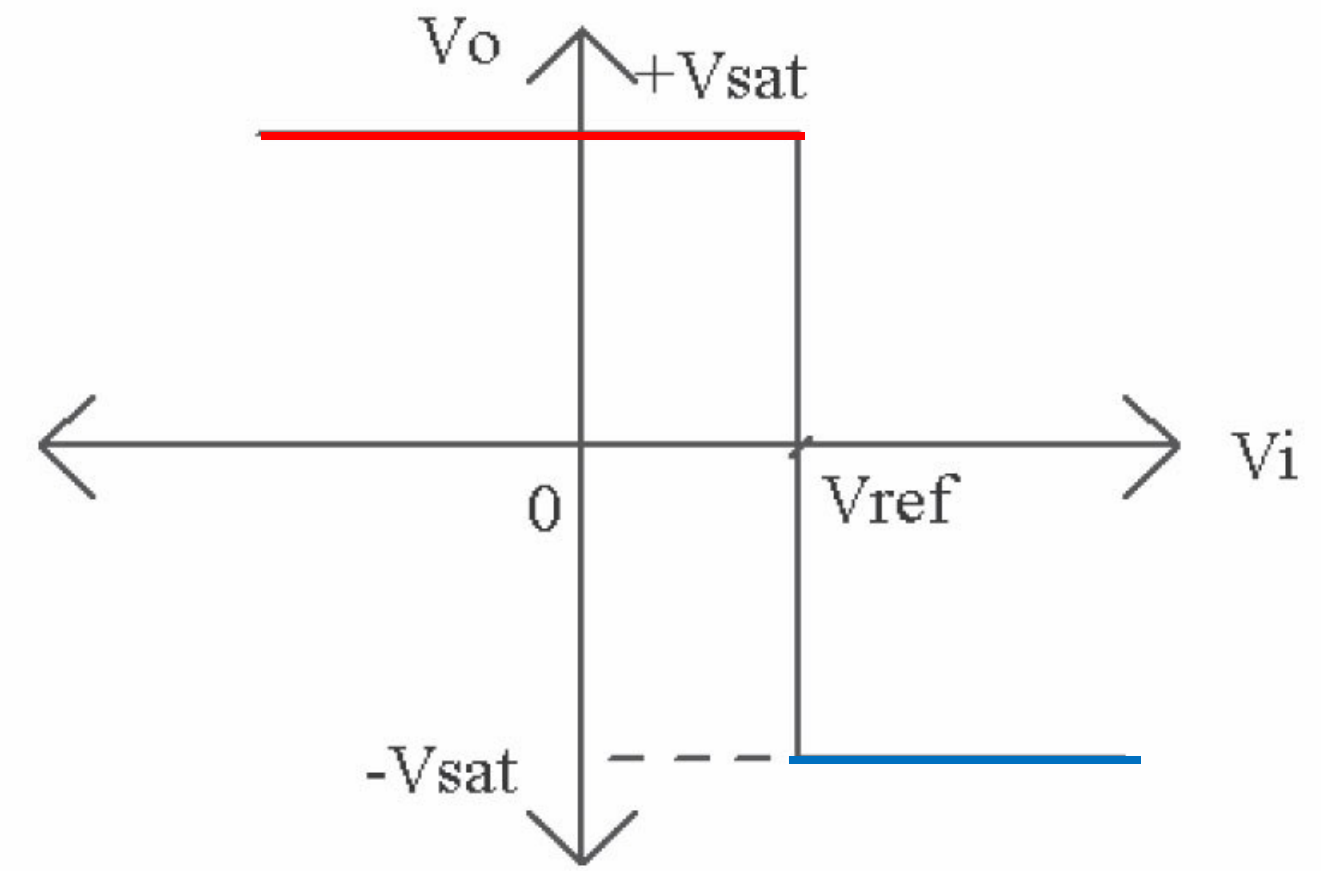
INVERTING VOLTAGE LEVEL DETECTOR



INVERTING VOLTAGE LEVEL DETECTOR

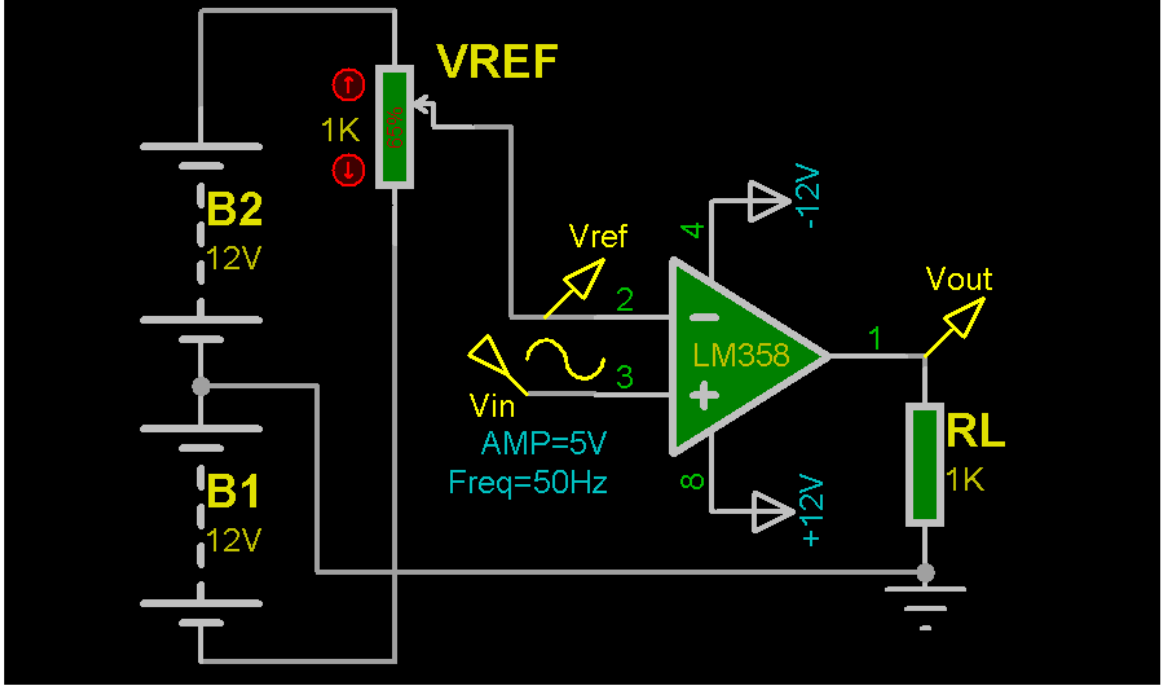


INVERTING VOLTAGE LEVEL DETECTOR

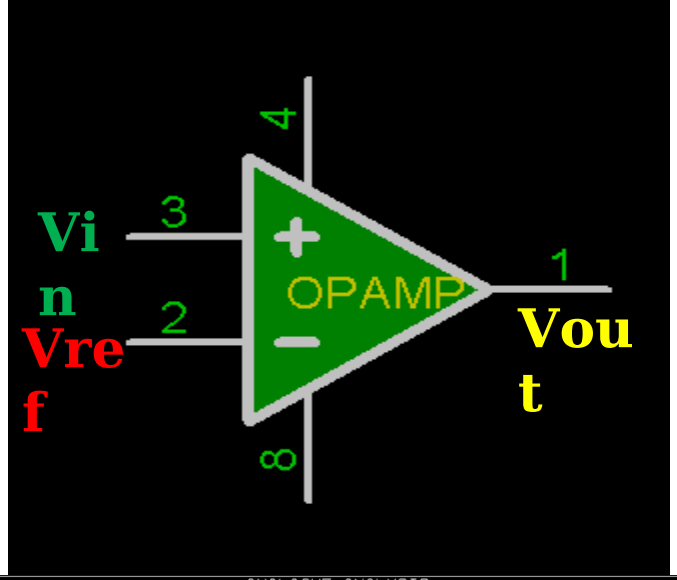


KARAKTERISTIK *INPUT-OUTPUT IVLD*

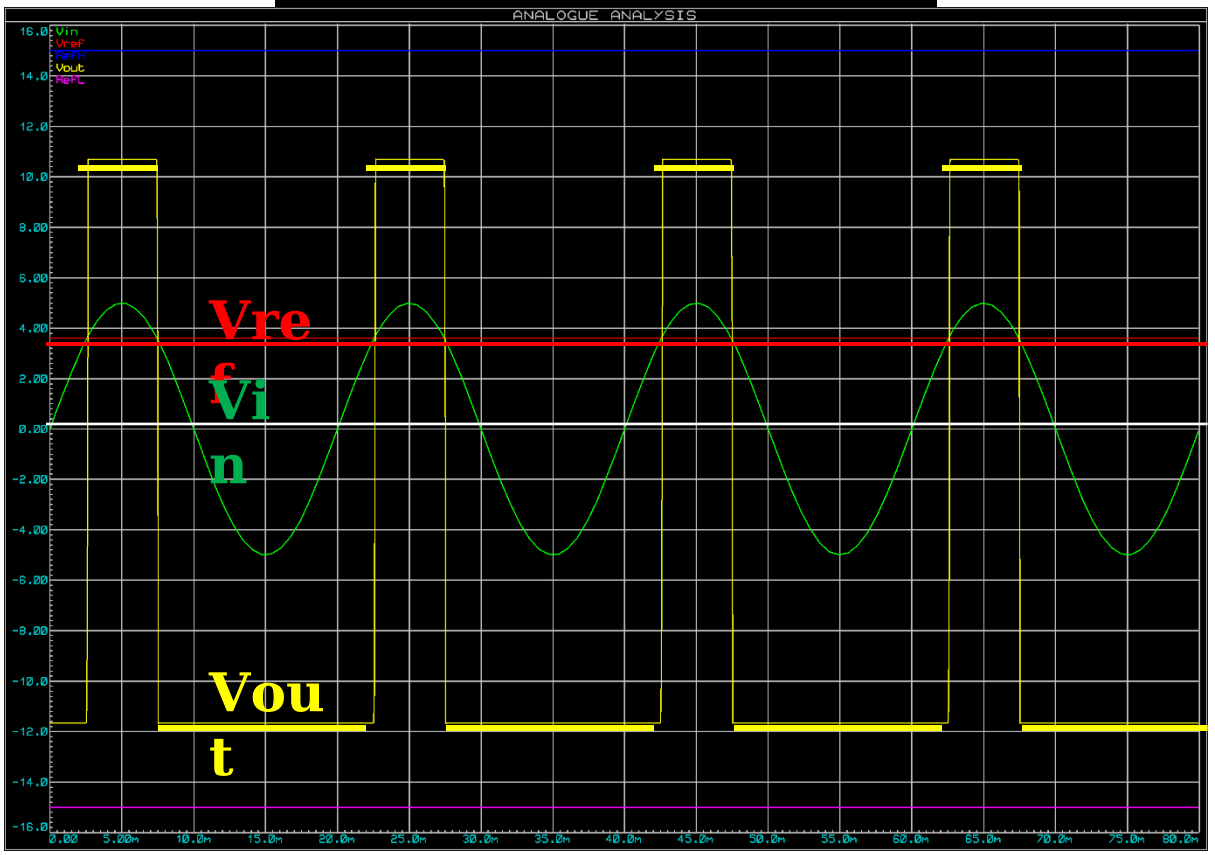
NON INVERTING VOLTAGE LEVEL DETECTOR (NIVLD)



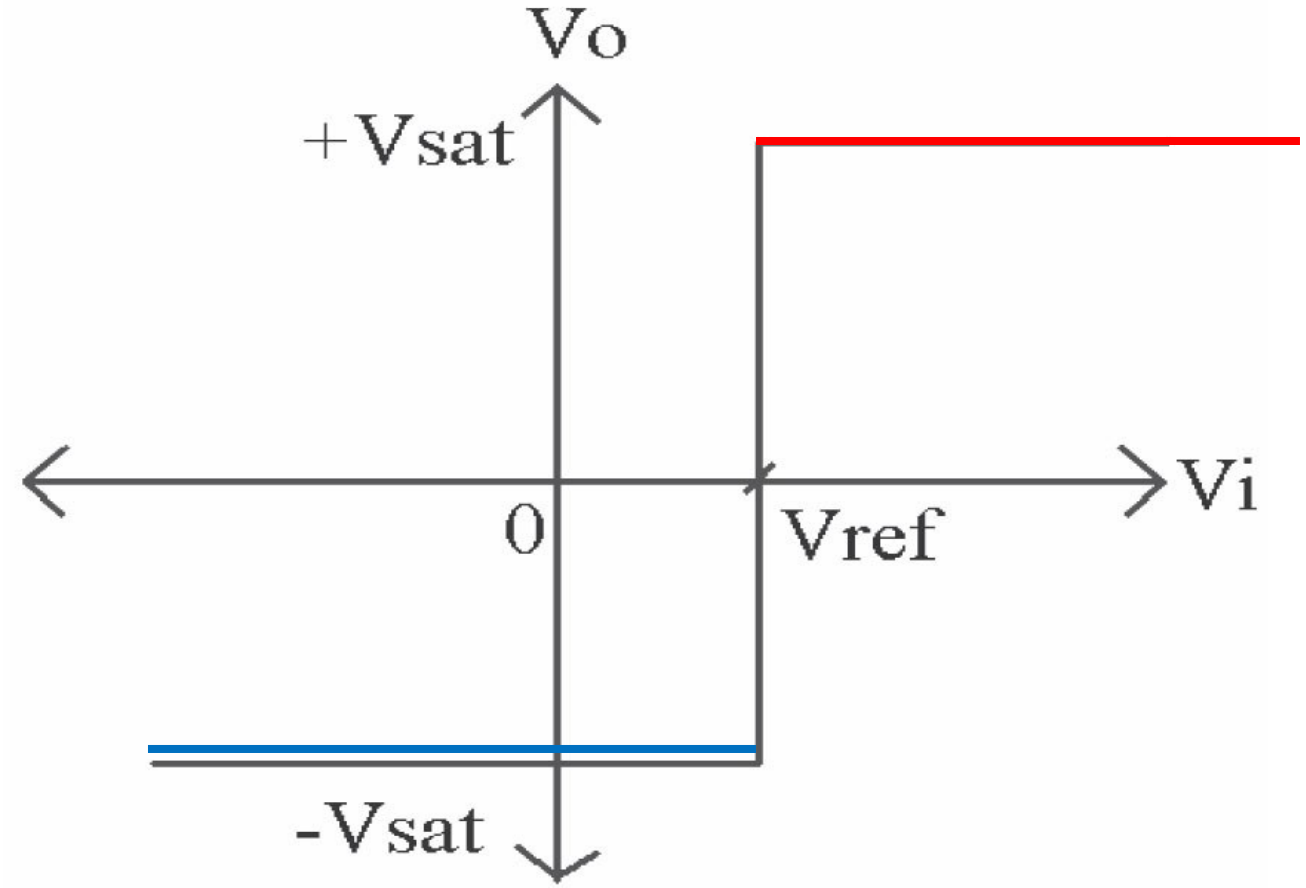
NON INVERTING VOLTAGE LEVEL DETECTOR



NON INVERTING VOLTAGE LEVEL DETECTOR

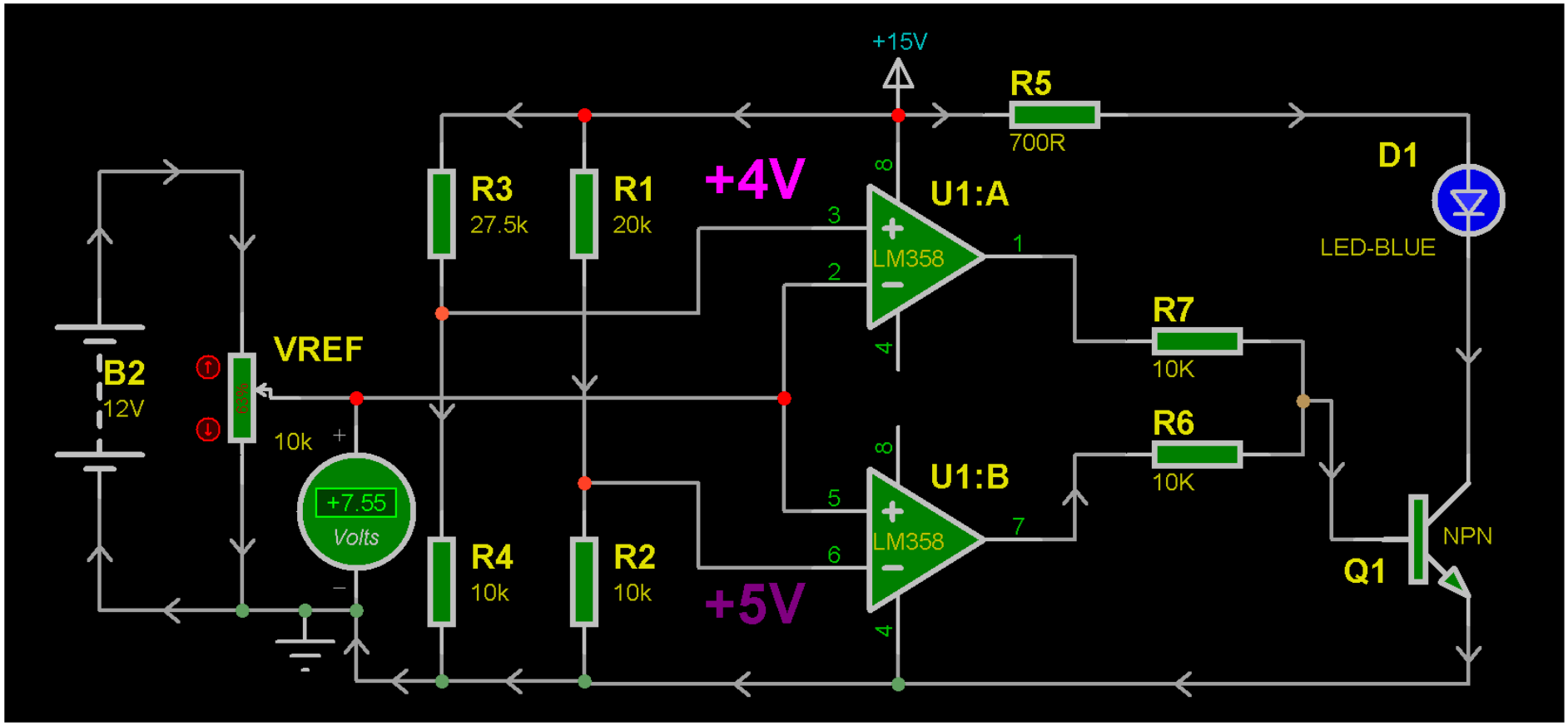


NON INVERTING VOLTAGE LEVEL DETECTOR



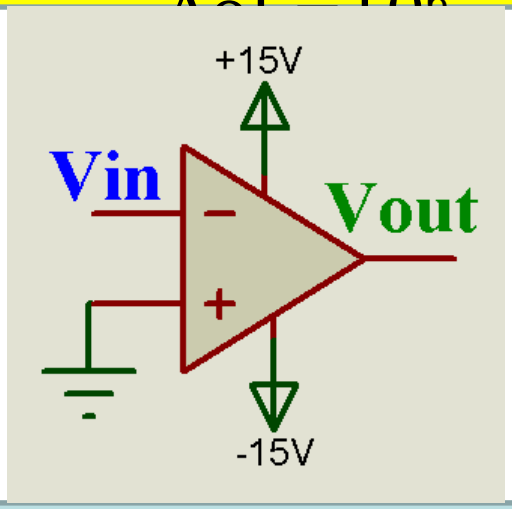
KARAKTERISTIK *INPUT-OUTPUT NIVLD*

DETEKTOR JENDELA (WINDOWS DETECTOR)



INVERTING ZERO CROSSING DETECTOR (IZCD)

Diketahui : ±Vsat = ±13 Volt dan AoL =10^6



Vout = (0 – Vin). AoL

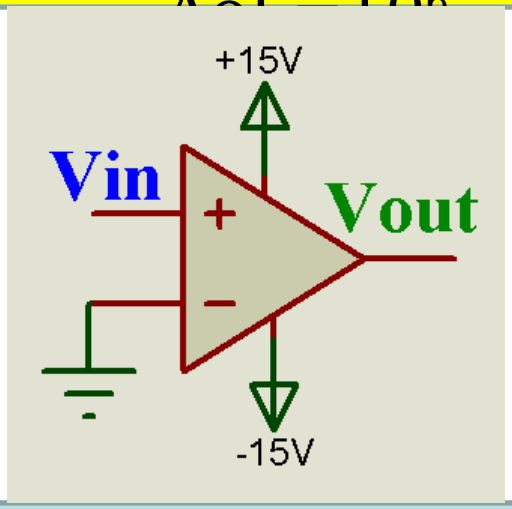
Jika Vin =14 mikroVolt, Vout = ?

Rangkaian *Inverting Zero Crossing Detector* dengan

Vout = -13 Volt

NON INVERTING ZERO CROSSING DETECTOR (NIZCD)

Diketahui : ±Vsat = ±13 Volt dan AoL =10^6



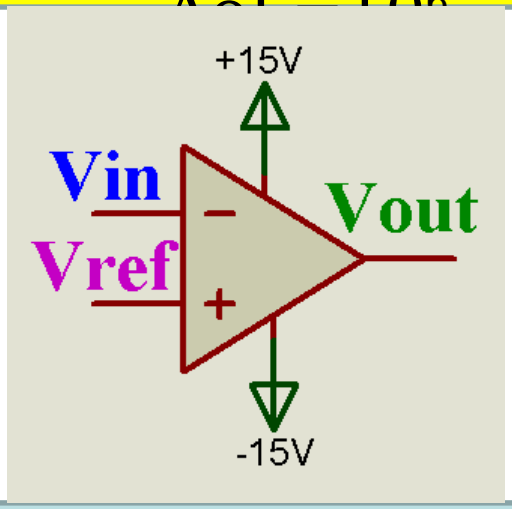
Vout = (Vin – 0). AoL

Jika Vin =14 mikroVolt, Vout = ?

Rangkaian *Non Inverting Zero Crossing Detector* dengan Vout = +13 Volt

INVERTING VOLTAGE LEVEL DETECTOR (IVLD)

Diketahui : ±Vsat = ±13 Volt dan AoL =10^6



Vout = (Vref – Vin). AoL

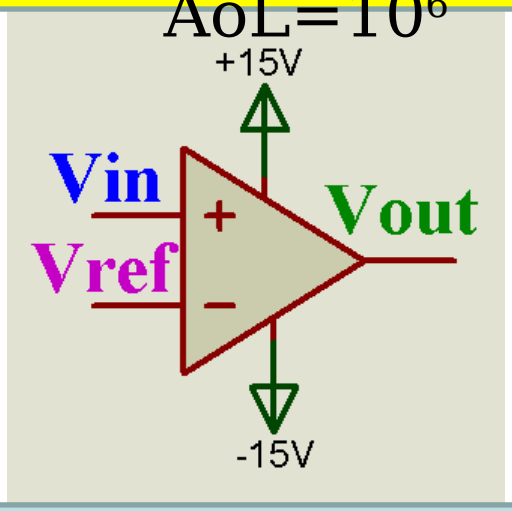
Jika Vin =10 mikroVolt dan Vref = -5 mikroVolt, Vout = ?

Rangkaian *Inverting Voltage Level Detector* dengan

Vout = -13 Volt

NON INVERTING VOLTAGE LEVEL DETECTOR (NIVLD)

Diketahui : ±Vsat = ±13 Volt dan AoL=10^6

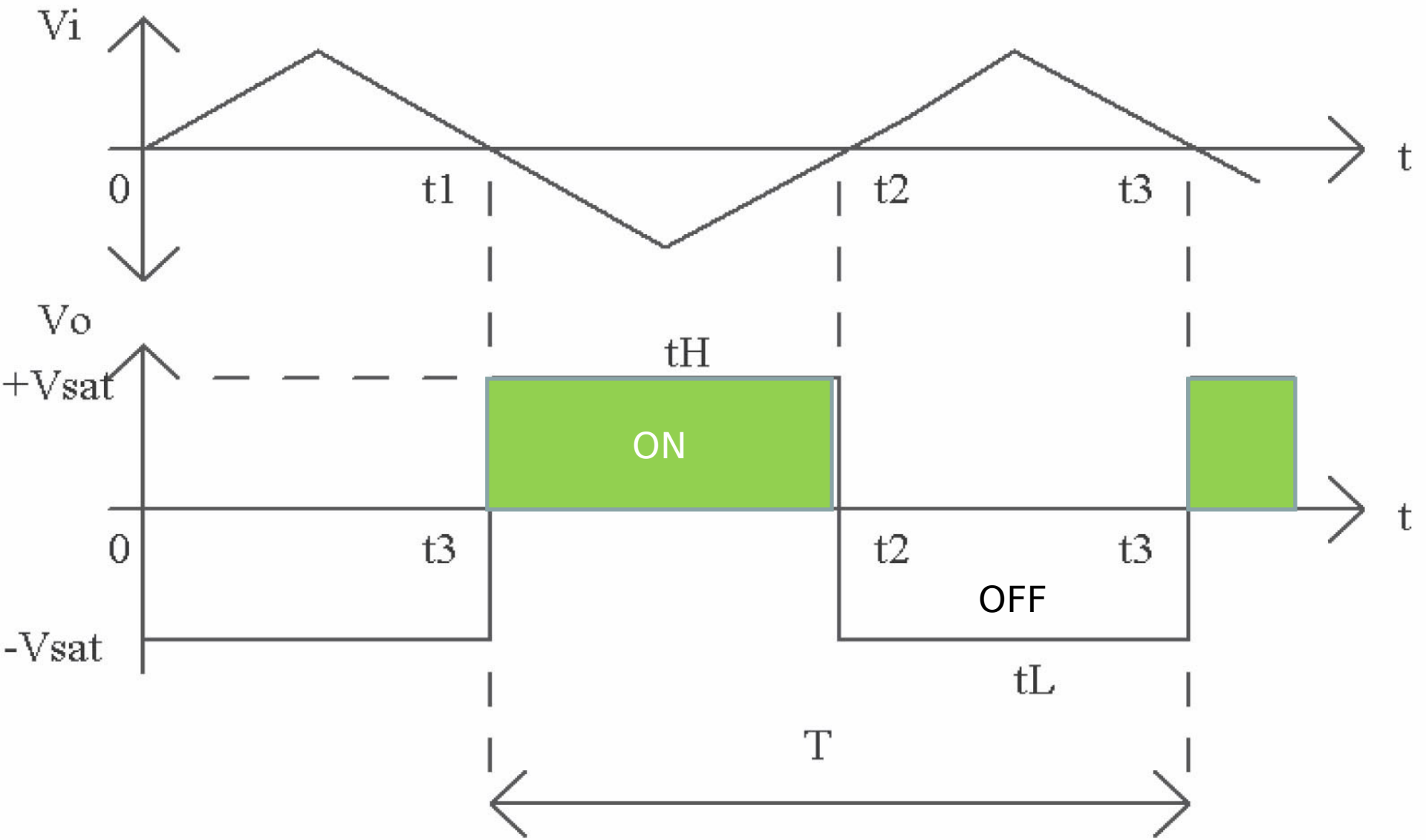


Vout = (Vin – Vref). AoL

Jika Vin = 10 mikroVolt dan Vref = -5 mikroVolt, Vout = ?

Rangkaian *Non-Inverting Voltage Level Detector* dengan Vout = +13 Volt

Siklus Kerja (*Duty Cycle(DC)*)



Siklus Kerja (*Duty Cycle(DC)*)

$$DC = \frac{t_H}{t_L + t_H} x\ 100\% = \frac{t_H}{T} x\ 100\%$$

Dimana,

DC adalah ***Duty Cycle*** dalam **persen**

t_H : **Waktu Positif** atau **Waktu Tinggi (*Hight time*)** satuannya **detik**

t_L : **Waktu Negatif** atau **Waktu Rendah (*Low time*)** satuannya **detik**

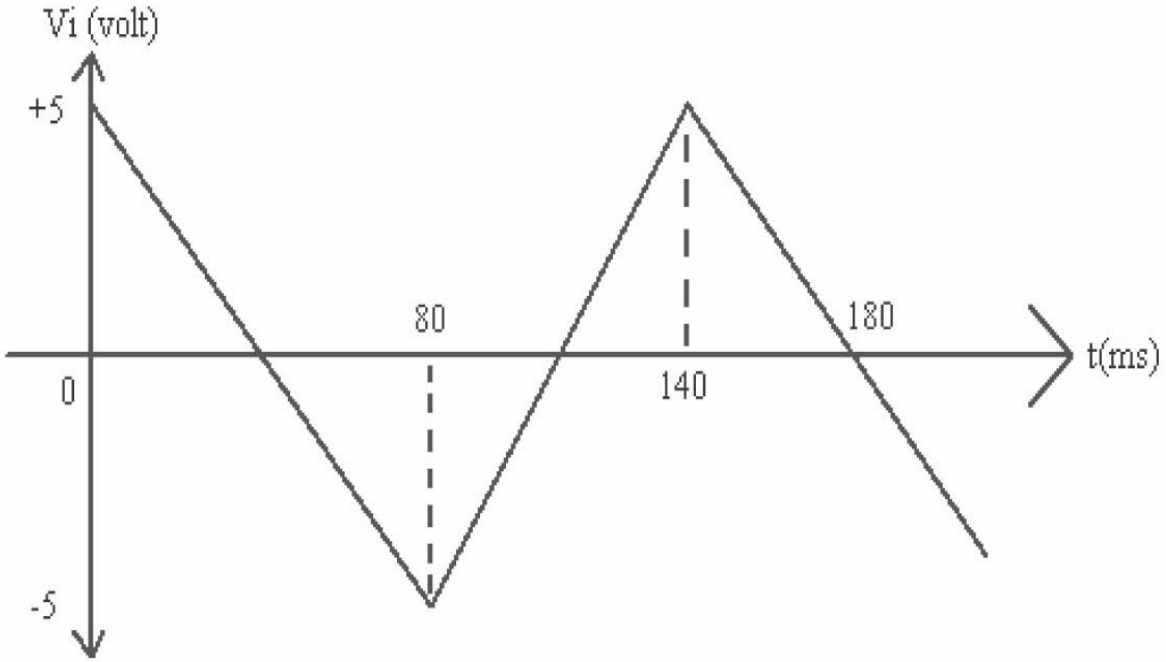
T : Periode Sinyal satuannya **detik**

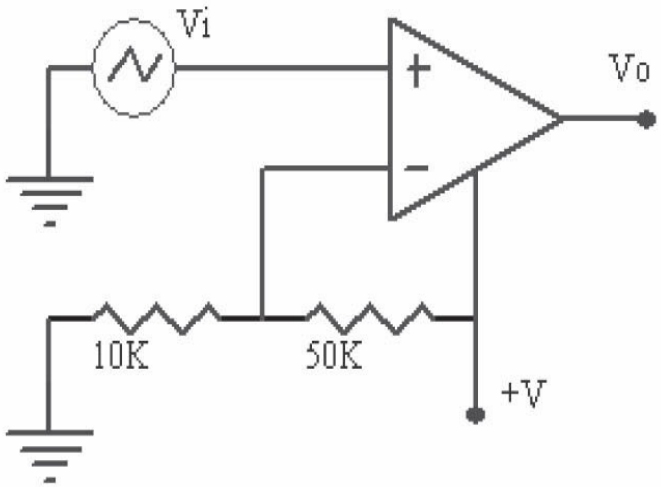
Contoh Soal 1

Diketahui: ± V = ± 15 volt; ± Vsat = ± 13 volt

a. Gambarkan tegangan *output* Vo!

b. Hitunglah t_L, t_H, dan *duty cycle*!





Penyelesaian 1

$$Vref = \frac{10\text{K}}{10\text{K} + 50\text{K}} \text{ x } (+15\text{V}) = 2{,}5 \text{ V}$$

Rangkaian *noninverting voltage Level Detector* (NIVLD)

Ed = non_inverting – inverting = Vi – Vref = Vi – 2,5

Untuk waktu : 0 < t < 80:

$$\text{Vi(t)} = \frac{-10}{80}\text{t} + 5$$

$$\text{Vi(t)} = -0{,}125\text{t} + 5$$

Pada saat t = t1, Vi(t)= 2,5 volt

Maka :

$$2{,}5 = -\ 0{,}125.\text{t1} + 5$$

$$0{,}125.\text{t1} = 5 - 2{,}5$$

$$\mathbf{t1} = \frac{2{,}5}{0{,}125} = \mathbf{20\ ms}$$

Untuk waktu: 80 < t < 140:

$$Vi(t) = \frac{10}{60}t + c$$

Pada saat t = 80, Vi(t) = -5 Volt
Maka:

$$-5 = \frac{1}{6}x\,(80) + c$$

Sehingga:

$$Vi(t) = \frac{1}{6}t - 18\frac{1}{3}$$

saat t = t2, Vi(t) = 2,5 volt
Maka:

$$2{,}5 = \frac{1}{6}t2 - 18\frac{1}{3}$$

t2 = 15 + 110 = 125 ms

Untuk waktu : 140 < t < 180:

$Vi(t) = -0{,}125.t + c$

Pada t = 140, Vi(t) = 5 volt.

Maka:

$5 = -0{,}125.(140) + c$

$c = 22{,}5$

Dan $Vi(t) = -0{,}125.t + 22{,}5$

Pada saat t = t3, Vi(t) = 2,5 volt.

Maka:

$2{,}5 = -0{,}125.t3 + 22{,}5$

$0{,}125.t3 = 22{,}5 - 2{,}5$

t3 = 160 ms

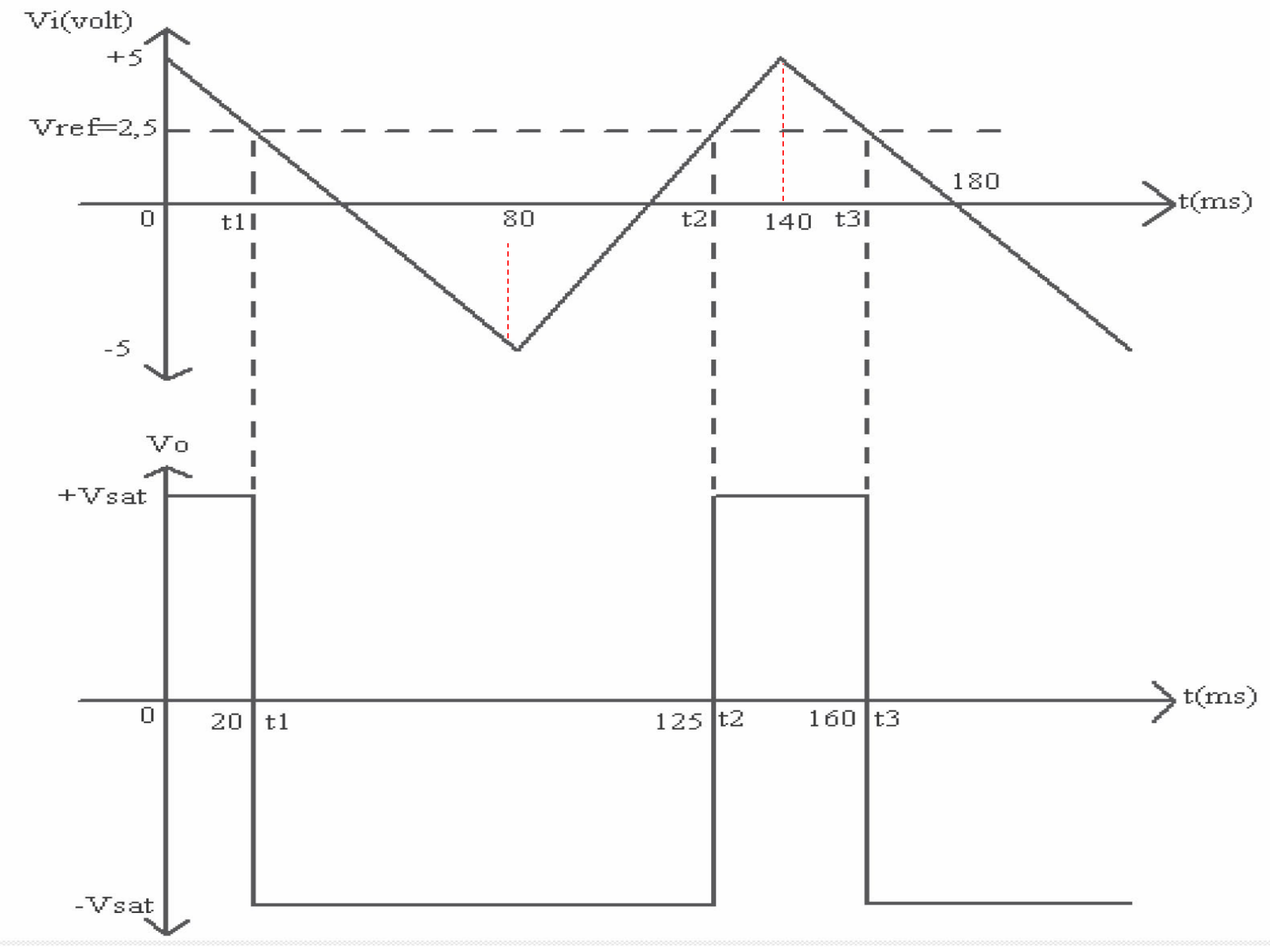
Maka :

tH = t3 – t2 = 160 - 125 **= 35 ms**

tL = t2 – t1 = 125 – 20 **= 105 ms**

T = tH + tL = 35 + 105 **= 140 ms**

Dutycycle(DC) $= \frac{tH}{T} x100\% = \frac{35}{140} x\,100\% = 25\,\%$

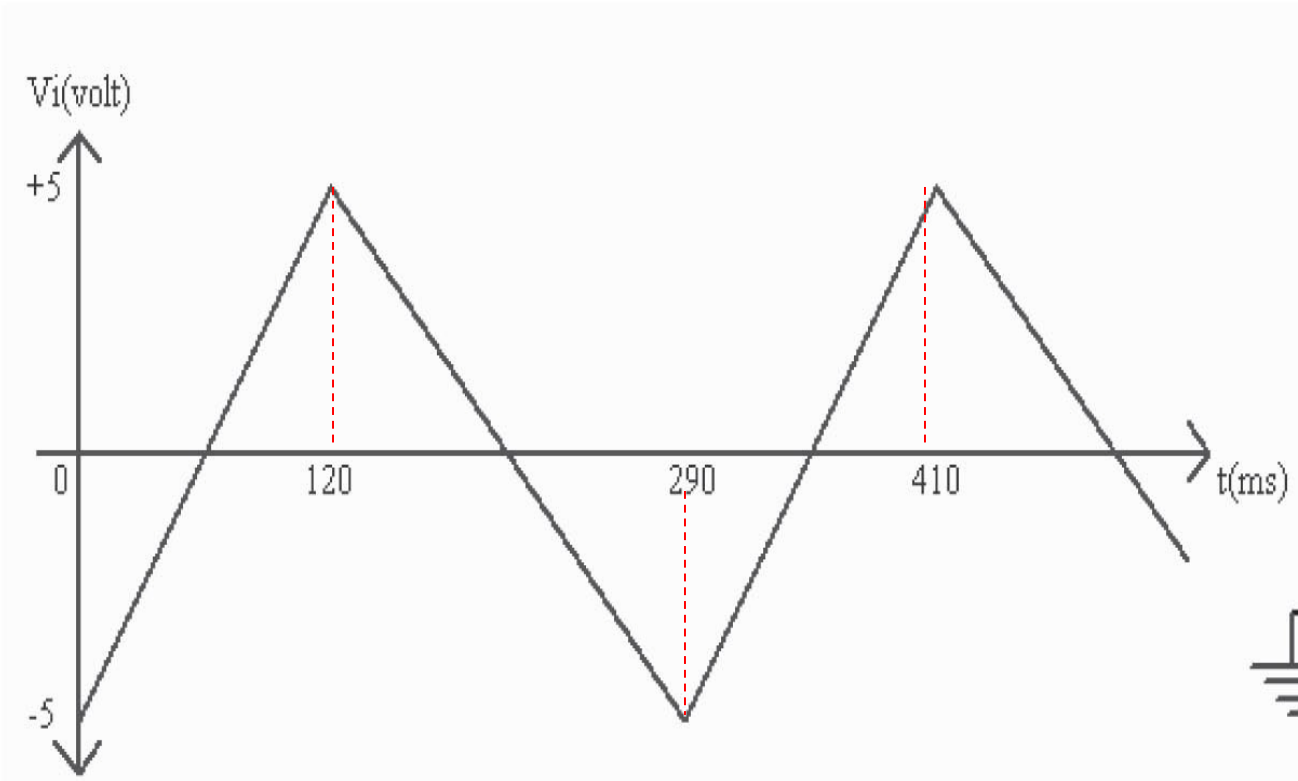

Vi(volt)
+5
Vref=2,5
0
t1
80
t2
140
t3
180
t(ms)
-5
Vo
+Vsat
0
20
t1
125
t2
160
t3
t(ms)
-Vsat

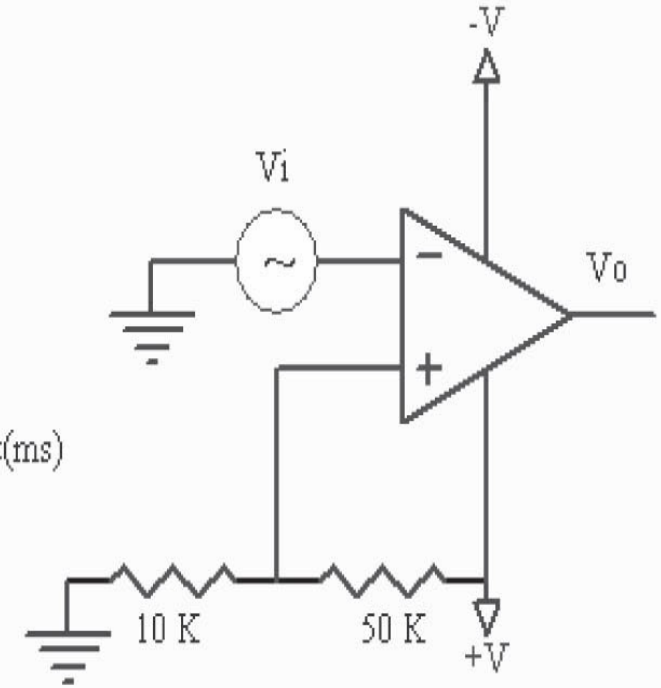
Contoh Soal 2

Diketahui: ± V = ± 15 volt; ± Vsat = ± 13 volt

a. Gambarkan tegangan *output* Vo!

b. Hitunglah t_L, t_H, dan *duty cycle*!





Penyelesaian 2

$$Vref = \frac{10K}{10K + 50K} \cdot (+15V) = 2{,}5 \text{ volt}$$

Rangkaian *inverting zero crossing detector* (IZCD).

$E_d = non_iverting - inverting = Vref - Vi = 2{,}5 - Vi$

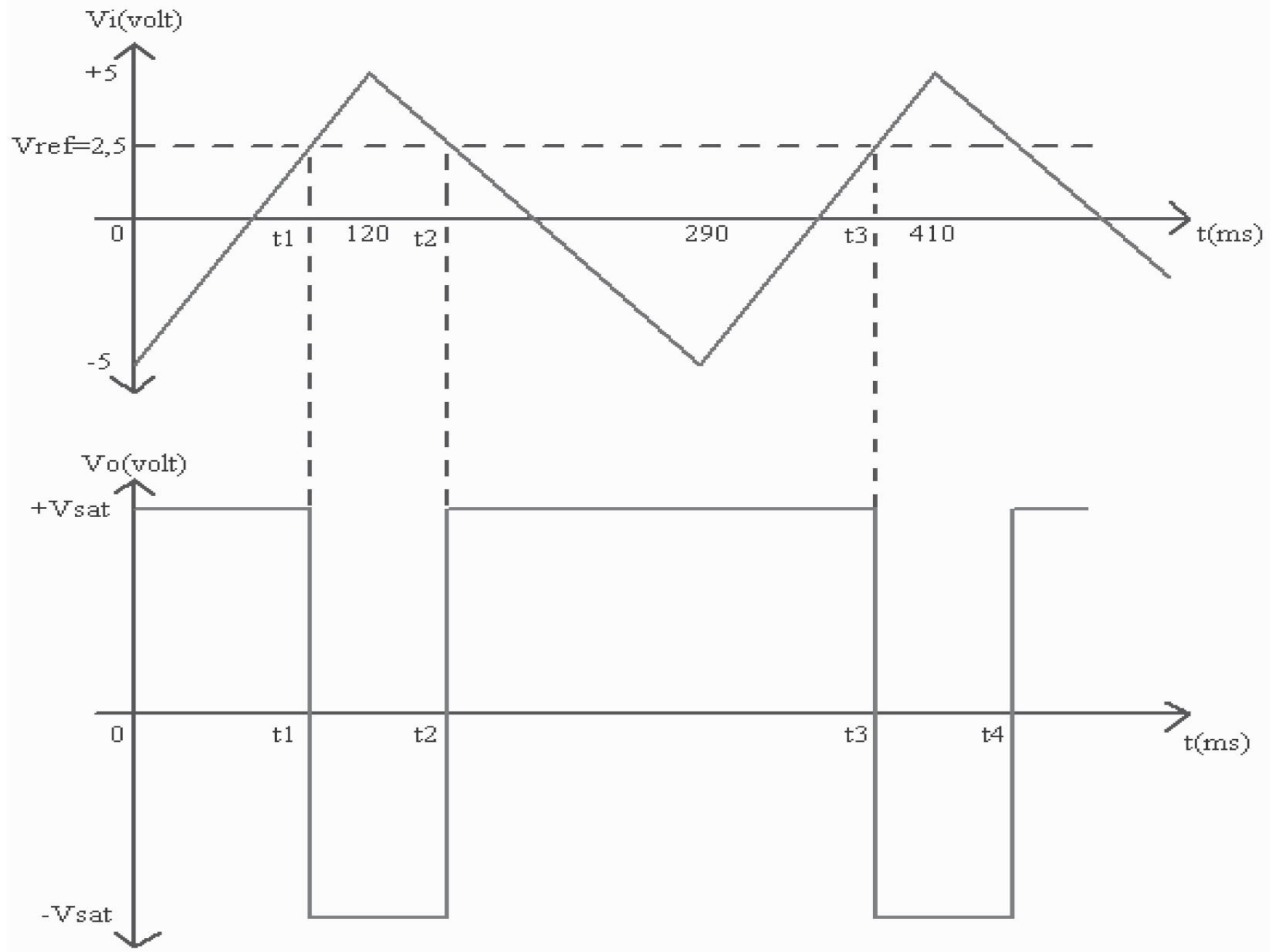
Untuk waktu: 0 < t < 120: $Vi(t) = \frac{10}{120}t - 5$

Pada saat t = t1, Vi(t) = 2,5 vol

Maka $2{,}5 = \frac{10}{120}t1 - 5$

$\frac{1}{12}t1 = 2{,}5 + 5$

$t1 = 90$ ms


Vi(volt)
+5
Vref=2,5
0
t1
120
t2
290
t3
410
t(ms)
-5
Vo(volt)
+Vsat
0
t1
t2
t3
t4
t(ms)
-Vsat

Untuk waktu: $120 < t < 290$: $Vi(t) = -\frac{10}{170}t + c$

Pada $t = 120$, $Vi(t) = 5$ volt.

Maka: $5 = -\frac{1}{17} \cdot (120) + c$

$C = 5 + \frac{120}{17} = 12\frac{1}{17}$

Dan $Vi(t) = -\frac{1}{17}t + 12\frac{1}{17}$

Pada saat $t = t2$, $Vi(t) = 2{,}5$ volt

Maka: $2{,}5 = -\frac{1}{17}.t2 + 12\frac{1}{17}$

$\frac{1}{17}.t2 = -2{,}5 + 12\frac{1}{17}$

$t2 = -42{,}5 + 205 = 162{,}5$ ms

Untuk waktu: $290 < t < 410$: $Vi(t) = \frac{1}{12}.t + c$

Pada saat $t = 290$, $Vi(t) = -5$ volt

Maka: $-5 = \frac{1}{12}.(290) + c$

$c = -5 - \frac{1}{12}.(290)$

$c = -5 - 24\frac{2}{12} = -29\frac{2}{12}$

Dan $Vi(t) = \frac{1}{12}.t - 29\frac{2}{12}$

Pada saat $t = t3$, $Vi(t) = 2,5$ volt

Maka: $2,5 = \frac{1}{12}t3 - 29\frac{2}{12}$

$\frac{1}{12}.t3 = 2,5 + 29\frac{2}{12}$

$t3 = 30 + 350 = 380$ ms

Maka $tH = t2 - t1 = 162,5 - 90 = 72,5$ ms

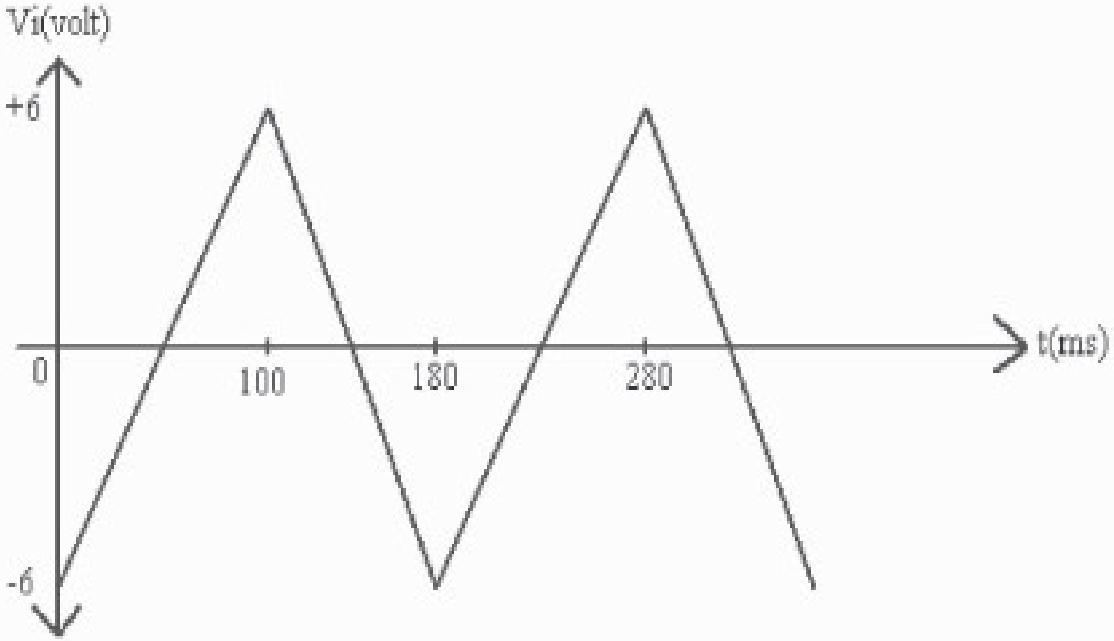
$tL = t3 - t2 = 380 - 162,5 = 217,5$ ms

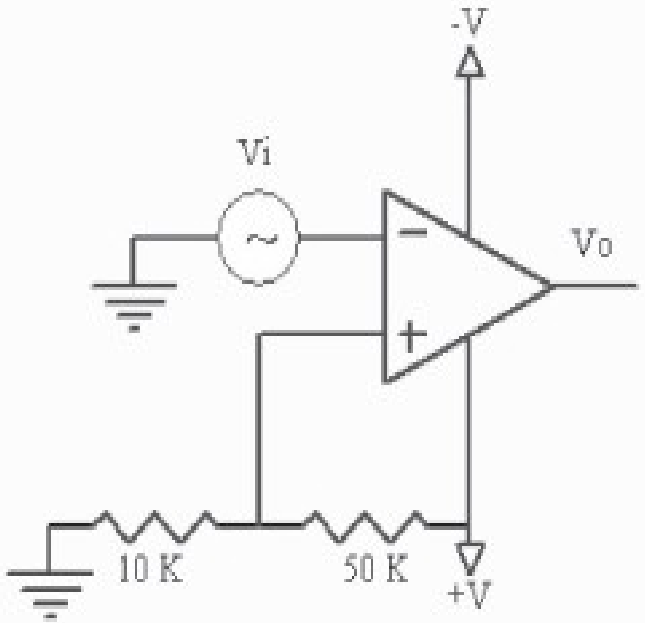
$T = tH + tL = 72,5 + 217,5 = 290$ ms

$$Dutycycle\ (DC) = \frac{tH}{T} \times 100\% = \frac{72,5}{290} \times 100\% = 25\%$$

Latihan Soal

1) Diketahui sebuah op amp dengan data: ± V = ± 12 volt ; ± Vsat = ± 10 volt
   a. Hitunglah tL, tH, dan *duty cycle*!
   b. Gambarkan tegangan *output* Vo!

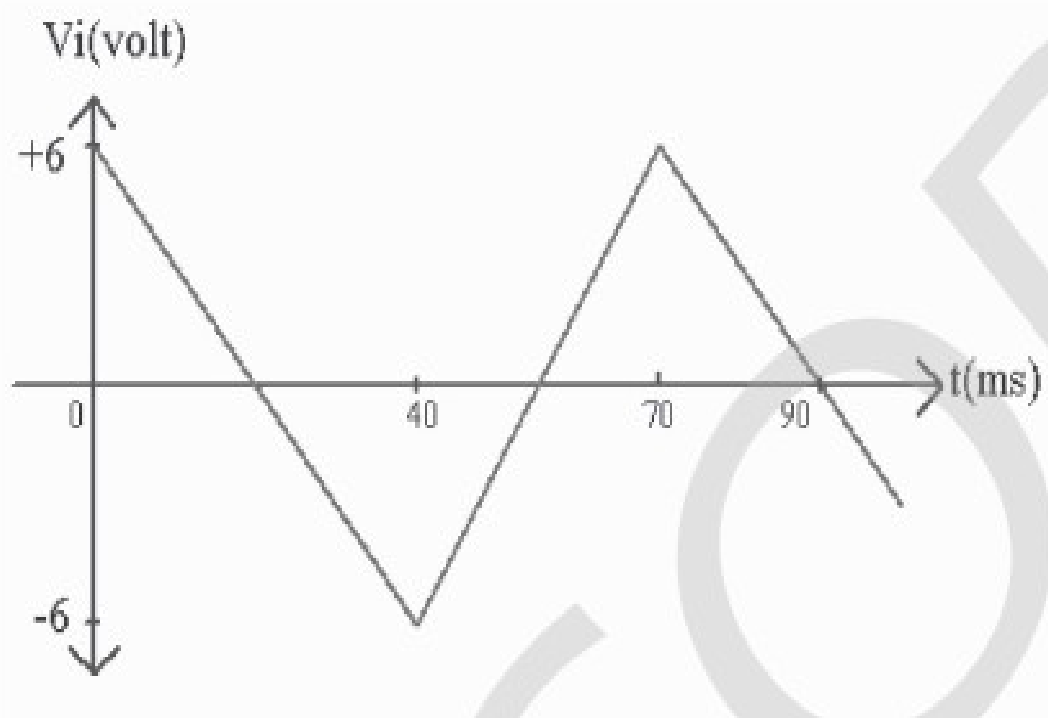


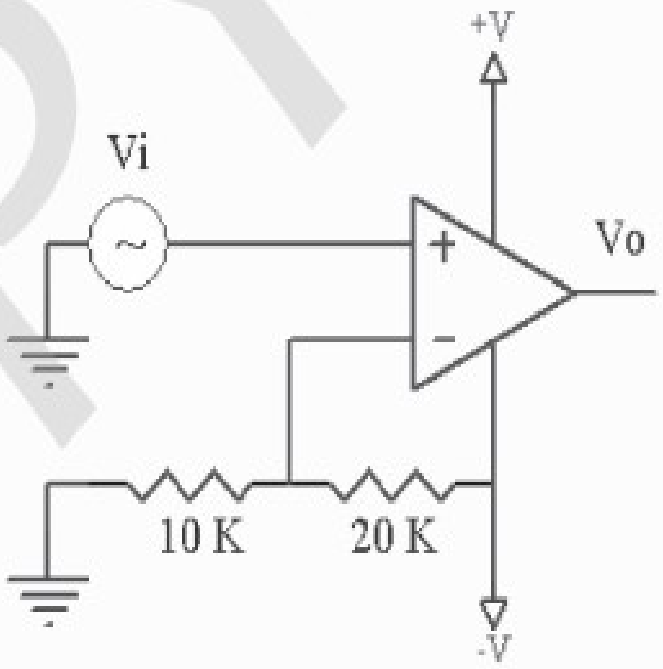


2) Diket: ± V = ± 15 volt ; ± Vsat = ± 13 volt

a. Hitunglah tL, tH, dan *duty cycle*!

b. Gambarkan tegangan *output* Vo!





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